THE NEW BRUNSWICK MUSEUM

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RARE AND VULNERABLE SPECIES IN NEW BRUNSWICK

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ABSTRACT

This report examines the status of 52 native New Brunswick species including 1 plant, 6 molluscs, 5 insects, 6 fishes, 2 amphibians, 23 birds and 7 mammals deemed to be rare or vulnerable in the province. In addition, the distribution and habitat requirements of each species are briefly described, and for most of these species maps showing sites of occurrence in New Brunswick are presented. Habitat alteration in its varied forms appears to present the most immediate threat to the populations of many of these species. The status of many species, particularly among the fungi, algae and invertebrates, remains unknown and unassessed due to a lack of information.

RESUME

Dans cet ouvrage, on présente, sous forme d'une liste annotée, un resumé et une analyse des connaissances sur l'état actuel des populations de 52 espèces rares et vulnérables au Nouveau-Brunswick. La liste comprend 6 mollusques, 5 insectes, 2 amphibiens, 23 oiseaux, 7 mammifères et une seule plante vasculaire. Pour chaque espèce, on décrit l'aire totale de sa distribution, sa répartition au Nouveau-Brunswick, son habitat, et les facteurs qui pourraient entraîner son déclin ou son extinction dans la province. Le texte est accompagné de cartes de distribution pour la plupart des espèces. Les populations d'un bon nombre de ces espèces son vulnérables à divers types d'altération de leurs habitats. A cause d'un manque d'information, l'état actuel de beaucoup d'espèces, surtout parmi les champignons, les algues et les invertébrés, demeure très peu connu et n'a pas été évalué.

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Plants

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INTRODUCTION

About 13,000 years ago, when the most recent of the great, continent-wide ice sheets began to retreat from the geographic area of New Brunswick, the freshly exposed ground and glacier-fed watercourses supported no plant or animal life. The pioneer, colonizing species of these vacant habitats came from areas to the south of the ice mass and perhaps also from then-exposed parts of the continental shelf to the east. The early post-glacial, terrestrial vegetation and its dependent fauna were probably similar in aspect and composition to certain types of present-day arctic tundra. Over the ensuing millenia, the climate warmed rapidly, tundra gave way to forests of birch and poplar, which, in turn, were replaced by other dominant trees. By about 5000 years ago, the tree composition of New Brunswick's forests had stabilized, and from then down to the present, only the relative abundance of the various genera has changed (Mott 1975).

While this cursory sketch does inadequate justice to the detail of the historical pollen and micro-fossil record preserved in New Brunswick's peat bogs and lake sediments, it does serve to emphasize that long-term change in species' distribution and abundance is a natural process. And change, of course, may include local or absolute extinction.

In recent time, however, in New Brunswick as elsewhere, the rate of these processes has accelerated greatly, as human activity has rapidly and radically altered the pre-settlement environment. The Passenger Pigeon and the New Brunswick population of the Woodland Caribou were among the early victims of our ignorance of the limited capacity of most natural populations to sustain intense exploitation. There is little doubt that the decline or local extinction of other,

less conspicuous species has gone unnoticed. In other cases, extinctions have been recorded only after the fact. Through extensive field work and an examination of old herbarium specimens, Hinds (1983) has determined that the flooding of rivershore habitat by the construction of the Mactaquac Dam on the Saint John River in the mid-1960s was responsible for the elimination of at least three vascular plants from the provincial flora. The flooded populations could likely have been transplanted up or downriver and out of danger, had a thorough botanical survey been undertaken beforehand.

In this report, **rare species** are considered to be those restricted to a small area as well as those of broader but consistently sparse occurrence in the province. The butterfly Hyllolycaena hyllus, commonly known as the Bronze Copper, is in New Brunswick known only from the immediate vicinity of the Jolicure Lakes and is an example of a geographically restricted rare species. The Common Loon exemplifies the second type of rarity. It nests on lakes throughout much of the province, but contrary to its name, the total number of breeding pairs is small. **Extirpated species** are those which, like the Timber Wolf, have become extinct in New Brunswick, but which still exist elsewhere.

It is important that our concept of **vulnerable species** not be confused with the definition adopted by the International Union for Conservation of Nature in its Red Data Book categories. In the IUCN scheme, the designation "vulnerable" refers to:

> taxa believed likely to be moved into the Endangered category [in danger of extinction] in the near future if the causal factors continue operating. Included are taxa of which most or all of the populations are decreasing because of over-

exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that are still abundant but are under threat from serious adverse factors throughout their range (Synge 1981).

Our use of the term "vulnerable" is not restricted to species which are believed likely to become endangered, given a continuation of present trends. The populations of some species that we consider to be vulnerable have apparently been stable for many years. For example, the Maritime Ringlet, a subspecies of the butterfly Coenonympha inornata, occurs only in salt marshes in the Bathurst area, where it was discovered in 1939. Although not immediately threatened, this genetically unique population could be quickly and irrevocably eliminated by uninformed or careless alteration of its habitat. In our view then, **vulnerable species** may be either potentially or actually subject to serious population decline. An implication of this definition is that a policy of "laissez faire" cannot adequately ensure the protection of certain species, which, although presently secure, could easily be jeopardized. The inclusion of species such as the Atlantic Salmon and the Little Brown Bat in this report emphasizes that not all vulnerable species can be categorized as rare.

This report draws together information on rare and vulnerable freshwater molluscs, butterflies and moths, fishes, amphibians and reptiles, birds and mammals. Marine organisms are not treated, although a number of pelagic seabirds and anadromous fishes are included. Vascular plants, with the exception of the Furbish's Lousewort (Pedicularis furbishiae), are excluded as The rare vascular plants of New Brunswick by Harold Hinds (1983) provides a comprehensive treatment.

Preliminary, annotated lists of rare and vulnerable species in each of the above taxonomic groups were forwarded to naturalists and professional biologists for critical review. Their comments, corrections and suggested additions were incorporated in a revised version of the text, and some sections were reviewed a second time. Other sources of information are indicated in the introduction to the various sections of the report.

Our hope, and that of the Environmental Protection Service in having initiated this project, is that the report will serve a number of purposes. It is intended primarily as a summary of the available information on the current status of rare and vulnerable species in New Brunswick. As such, it aims to alert policy makers, resource developers and conservationists to the actual or potential threats to these species. Our work has also identified or highlighted a number of species and higher taxonomic groups which are very inadequately known in the province. The algae, fungi and most groups of invertebrate animals stand out in this respect. Among the species included in the report, some present biogeographic and ecological problems of considerable interest, owing to their disjunct or narrowly endemic distributions. If the report succeeds in persuading more people of the inherent interest in these and other rare and vulnerable species, leading thereby to an increased concern for their protection, it will have served its most valuable purpose.

The most effective way to protect rare and vulnerable species is to protect the habitats upon which their local or overall survival depends. Conflicts over the development versus the preservation of natural areas are understandably accentuated in a province like New Brunswick, whose economy is based largely on the exploitation of its forest, wildlife and mineral resources. In recent years, individuals

and organizations concerned with the preservation of the natural diversity of species and ecosystems in the province have constituted a growing political constituency. This is reflected in the establishment of two legislative acts which deal specifically with the protection of species and natural areas.

The New Brunswick Endangered Species Act (1974) stipulates that "no person shall kill, injure, harass or interfere with...any member of an endangered species of fauna" and that "no person shall destroy or interfere with...any member of an endangered species of flora or the habitat of an endangered species of flora". To date, three birds (Bald Eagle, Osprey, Peregrine Falcon), two mammals (Lynx, Eastern Panther) and one vascular plant (Furbish's Lousewort) have been declared endangered under the Act. Of these, only the Osprey is not included in this report. On the basis of its currently healthy breeding population in New Brunswick, it has been suggested that the Osprey may be safely removed from the endangered species list (R.F. Stocek, pers. comm.; see Christie 1981).

An important shortcoming of the Endangered Species Act, recently examined in detail by Versteeg (1984), is that no direct provision is made for the protection of the habitat of endangered animals. While such a clause may have been excluded from the Act in view of the difficulty in circumscribing or adequately protecting the habitat of wide-ranging animals, the populations of certain potentially endangered species such as the Gray Treefrog or Maritime Ringlet Butterfly are relatively sedentary and their habitats readily definable. Similarly, only a few of the bird species included in this report are year-round residents in the province, but during the critical nesting season, nearly all of them are restricted to specific vulnerable habitats.

The New Brunswick Ecological Reserves Act (1975) provides for the establishment of reserves "...that are representative examples of natural ecosystems within the Province; ...in which rare or endangered native plants and animals in their natural habitat may be preserved; and that contain unique or rare examples of botanical, zoological, pedological or geological phenomena." To date, no reserve has been created which would safeguard the habitat of a rare or vulnerable species in New Brunswick. Reserves have been proposed, however, that would protect the Furbish's Lousewort, two butterflies (the Maritime Ringlet and Salt Marsh Copper), and one of the few major known bat hibernacula in the province.

The New Brunswick Department of Natural Resources (Fish and Wildlife Branch) is responsible for the administration of both of these acts. In the case of the Ecological Reserves Act, the Environmental Council advises the Minister and submits an annual report on the creation, modification or abolition of reserves as well as on any other matter coming within the Act. This council is made up of at least five private citizens appointed by the Lieutenant Governor pursuant to the Clean Environment Act, and it serves as a medium for public input into government policy and action. There is a need, as yet unfilled, for a similar group with responsibility for the Endangered Species Act.

The information on each species in the list is organized as follows:

Identification Reference to a book or monograph which contains a description and illustrations of the species or subspecies.

Distribution Range in New Brunswick and overall geographic range.

Habitat Habitat in New Brunswick.

Vulnerability Assessment of the actual or potential threats to the species or subspecies in New Brunswick.

Distribution maps are provided for most species following the text of the report. The maps plot the recorded New Brunswick locations based on a survey of literature records and on the collections and files of the New Brunswick Museum, the Canadian Wildlife Service, and the National Museum of Natural Sciences, Ottawa. In some cases, the maps must be regarded as provisional, reflecting the uneven intensity of collecting rather than the complete range of the species in the province.

Detailed biogeographic information is indispensable in assessing the status of an organism, as well as in understanding its ecology and systematics. As both Danks (1983) and Bateman (1975) have noted, regional information centres such as museums can play a leading role in collecting, storing and disseminating this information. The New Brunswick Museum maintains such records and readers with additions, deletions, comments or corrections to this report are urged to send details to:

Natural Science Department
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PLANTS

The distribution, habitat and status of New Brunswick's rare vascular plants have been thoroughly documented by Hinds (1983), and for this reason, they are not treated in the present report. One exception has been made: Pedicularis furbishiae is the only plant protected by the New Brunswick Endangered Species Act and has been included as a notable example of a species which is extremely vulnerable to habitat destruction.

The algae and bryophytes are not included. It should be noted, however, that the recently published Moss Flora of the Maritime Provinces by R.R. Ireland (1982) identifies many rare and (or) localized (or seldom collected) mosses in New Brunswick, some of which are undoubtedly vulnerable to habitat destruction. Especially noteworthy in this respect is the considerable number of rare species confined to calcareous soil or bedrock. At least 15 species in this substrate category are as yet, in New Brunswick, known only or largely from calcareous Ordovician-Silurian sedimentary rocks in Victoria and Restigouche Counties in the northwestern part of the province.

At least two extremely rare and vulnerable (if not extirpated) species of lichens occur in New Brunswick. The original (type) description of the foliose lichen Erioderma pedicellatum was based on a collection made by W.G. Farlow on Campobello Island in 1902. Later re-examination of this collection showed that a second species, E. mollissimum was present along with the original material of E. pedicellatum (Jorgensen 1972). Farlow's collection notes indicated that the specimens were growing "on branches" but gave no further details of the habitat or exact locality on Campobello Island.

Erioderma pedicellatum is known elsewhere only from moist Balsam Fir (Abies balsamea) forests in the vicinity of Long Pond in

eastern Newfoundland and from central Norway and Sweden, where it appears to have disappeared as a result of modern, intensive forestry practices (Maass 1980). The only other known locality for E. mollissimum in North America is the Great Smoky Mountains in the southeastern United States. Recently, Maass (1980) made an extensive, unsuccessful search for Erioderma on Campobello Island and concluded that its apparent elimination might be the result of logging, forest fires or the budworm-related decline of the Balsam Fir. It is possible that either or both species still occur(s) in relict mature coniferous forests in the cool, humid coastal zone along the Bay of Fundy.

SPECIES ACCOUNTS

Pedicularis furbishiae S. Watson Furbish's Lousewort

Identification Refer to The Flora of Canada by H.J. Scoggan (1978-1979) p. 1366.

Distribution (see Map 2). Endemic to the upper Saint John River valley between Andover, New Brunswick and Little Black Rapids, Maine (Stirrett 1977). The entire population of P. furbishiae in New Brunswick is estimated at approximately 550 plants in 3 separate colonies (Day 1983).

Habitat Restricted to partly shaded, unstable river banks between the high water erosion level and the edge of the forest (Lucas and Synge 1978). One of the three known New Brunswick colonies occupies a railway embankment near the Saint John River. Cutting of the overstory of brush by railway crews has apparently maintained suitable habitat conditions for the Lousewort population at this site (Day 1983).

Vulnerability Vulnerable to habitat destruction by flooding (as a result of dam construction), road or residential (cottage) development on the river shore, and to overcollecting (since its status and localities are becoming well known). Pedicularis furbishiae is the only plant species protected by the New Brunswick Endangered Species Act. Section 5 of the Act stipulates that "no person shall destroy or interfere with or attempt to destroy or interfere with any member of an endangered species of flora or the habitat of an endangered species of flora". The plants and habitat of P. furbishiae in Maine are protected by the U.S. Endangered Species Act.

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MOLLUSCS

Only the freshwater molluscs are considered in this section. Detailed information on the provincial status and distribution of these species is scanty however. The land snails of New Brunswick are even less well known, although several native species are apparently at the northern limit of their range in the province. This is especially true of the family Polygyridae (D.S. Davis, pers. comm.). Many native land snails are closely dependent on well developed, undisturbed forest soils and thus are vulnerable to habitat change resulting from forest cutting. Further systematic surveys of the type undertaken in Fundy National Park (Clarke et al. 1968) would provide a means of identifying vulnerable species according to rarity and habitat requirements.

Biologically and taxonomically, the freshwater molluscs include two classes in New Brunswick:

1) Snails (class Gastropoda)

   a) Prosobranchs: obtain oxygen from water through gills. Most species possess an operculum (a horny plate which serves to close the opening to the shell).

   b) Pulmonates: obtain oxygen from air through lungs; lack an operculum. The freshwater pulmonates must come to the surface to breathe. (All of the New Brunswick land snails are included in this category).

2) Bivalves (class Pelecypoda)

a) Freshwater mussels (or naiads): distinguished from all other freshwater molluscs by a special larval stage known as a glochidium. The glochidia larvae are released from adult female mussels and must attach to the gills, fins or skin of specific host species of fish in order to undergo metamorphosis to the free-living adult stage.

b) Sphaeriids (fingernail and pea clams): smaller than mussels; larval stages brooded by adults.

The Freshwater Molluscs of Canada by A.H. Clarke (1981) provides a synopsis of information on the distribution and ecology of the New Brunswick species. The status of each taxonomic group is summarized below.

Prosobranchs (or operculates). Five freshwater species are known from New Brunswick. Lyogyrus granum is restricted in Canada to southern New Brunswick (Clarke 1981) and Nova Scotia (D.S. Davis, pers. comm.) and for this reason, is included tentatively as a vulnerable species.

Pulmonates. Sixteen species are known from New Brunswick. Most of these are widely distributed, but the River Limpet (Ferrissia rivularis) is apparently at the northeastern limit of its range in western New Brunswick (absent from Nova Scotia). It may prove to be a vulnerable species.

Freshwater mussels. Of 11 species known to occur in the province, four have been included in the list of vulnerable species on account of their restricted ranges in Canada. In none of these species is the host fish of the glochidia larval stage known. Basic biological information of this sort is indispensable for an adequate assessment of the vulnerability of these species.

Sphaeriids. Twenty species are known from New Brunswick, many of which are widely distributed in North America. None is included in the present report. According to the distribution maps in Clarke (1981), the following species are at the northeastern limit of their range in New Brunswick (absent from Nova Scotia):

Sphaerium rhomboideum (Say)
S. striatinum (Lamarck)
S. occidentale (Prime)
Pisidium equilaterale Prime

Water pollution and physical habitat alteration are the two main threats to freshwater mollusc populations in New Brunswick. Pollution may be thermal (heating of river water for industrial cooling), organic (sewage, wood products waste, pesticides) or inorganic (toxic industrial or mining wastes) (Hart and Fuller 1974; Clarke 1981). An example of heavy metal pollution is provided by Wurtz (1962, cited in Hart and Fuller 1974) who reported that one year after water was pumped from a base metal mine (Zinc, Lead, Copper) into the Northwest Miramichi River, the molluscan fauna was still absent for 12 miles below the outflow. At the time of observation, five species of molluscs were present upriver from the source of pollution.

Physical alteration of freshwater mollusc habitat may take the form of siltation or changes in water level, currents and aquatic vegetation. These changes may result from dam or causeway construction, soil erosion (caused by agriculture, forest cutting on river shores, road-building, etc.), river dredging or beach development.

SPECIES ACCOUNTS

Lyogyrus granum (Say) Rusty Spire Snail

Identification Refer to The Freshwater Molluscs of Canada by A. H. Clarke (1981) p. 62.

Distribution (see Map 3). In Canada known only from southern New Brunswick (Clarke 1981) and Nova Scotia (D.S. Davis, pers. comm.). Occurs south to Virginia on the Atlantic Coastal Plain. The western limit is unknown. In New Brunswick this species has apparently been collected at only three localities: a small tributary of the Jemseg River, Queens Co.; on the Oromocto River, east of the south end of Sunpoke Lake, Sunbury Co.; and along Baker Brook, east of Lincoln, Sunbury Co. (National Museum of Canada (NMC) collections).

Habitat Occurs on the leaves of various species of submersed aquatic plants, or on dead tree leaves on the bottom, in still or slow-moving perennial-water habitats. Nothing has been published on its biology.

Vulnerability Difficult to assess. The gill-breathing snails are more susceptible to low oxygen concentrations (and thus to certain types of pollution) than the freshwater pulmonates (Clarke 1981).

Ferrissia rivularis (Say) Sturdy River Limpet

Identification Refer to The Freshwater Molluscs of Canada by A.H. Clarke (1981) p. 226.

Distribution (see Map 4). This species is at the northeastern limit of its range in western New Brunswick (Clarke 1981). There is a single provincial record in the NMC collection from near the mouth of the Aroostook River, Victoria Co. In North America occurs from Saskatchewan east to New Brunswick and southward to North Carolina and Wyoming.

Habitat Lives attached to rocks and mussel shells in rivers and creeks or attached to rocks in exposed habitats in lakes.

Vulnerability May be vulnerable to the effects of acid rain and water pollution. Exact status unknown at this time and impossible to assess without further study. The apparent rarity of this mollusc in New Brunswick may be due to insufficient field work in the province or the species may have been overlooked due to its small size (M.F.I. Smith, pers. comm.).

Alasmidonta heterodon (Lea) Dwarf Wedge-Mussel

Identification Refer to The Freshwater Molluscs of Canada by A.H. Clarke (1981) p. 274.

Distribution (see Map 5). In Canada recorded only from the Petitcodiac River and a tributary, the North River, Westmorland Co., New Brunswick (NMC collections), where Clarke (1981) reports it as common. The species is discontinuously distributed in the rivers of the Atlantic drainage from the Petitcodiac south to the Neuse River, North Carolina.

Habitat Medium to slow-flowing rivers of varying size, on gravel, sand or muddy bottoms and sometimes among submersed aquatic plants (Clark and Berg 1959). The host fish of the glochidia larvae is unknown.

Vulnerability Considered an endangered species in Canada (Clarke 1977). Vulnerable to pollution or physical habitat alteration.

Alasmidonta vericosa (Lamarck) Swollen Wedge-Mussel

Identification Refer to The Freshwater Molluscs of Canada by A.H. Clarke (1981) p. 280.

Distribution (see Map 6). In New Brunswick, known only from the Petitcodiac River, Westmorland Co. (NMC collections). Occurs in the Atlantic drainage from Nova Scotia and New Brunswick south to North Carolina (Clarke 1981).

Habitat Usually found in moderate to rapidly flowing streams; often in riffles or rapids and in sand or among gravel or rocks (Athearn and Clarke 1962). The host fish of the glochidia larvae is unknown.

Vulnerability Vulnerable to pollution or physical habitat alteration.

Lampsilis cariosa (Say) Yellow Lamp-Mussel

Identification Refer to The Freshwater Molluscs of Canada by A.H. Clarke (1981) p. 336.

Distribution (see Map 7). Clarke (1977) stated that this species is found in Canada only in the Sydney River west of Sydney, Nova Scotia, but later (Clarke 1981) reports an additional locality in south-central New Brunswick (Saint John River, south side McKinley Ferry crossing, 13 km west of Fredericton; NMC collections).

Habitat Predominantly a river species. It occurs chiefly in rather swift currents on shoals or in riffles and principally on sand bottoms, occasionally in ponds.

Vulnerability Considered to be a potentially endangered species in Canada owing to its restricted distribution (Clarke 1977, 1981). Vulnerable to pollution or physical habitat alteration.

Lampsilis ochracea (Say) Ocher (or Delicate) Lamp-Mussel

Identification Refer to The Freshwater Molluscs of Canada by A.H. Clarke (1981) p. 340.

Distribution (see Map 8). In New Brunswick this species has been collected at only three sites: Morice Lake, Upper Sackville and at a lake on the west branch of the Aulac River, 13 km northeast of Sackville, both in Westmorland Co. (NMC collections); also at an unspecified locality on the Saint John River in Queens County (Athearn 1961). The Ocher Lamp-Mussel occurs in the Atlantic drainage from Cape Breton, Nova Scotia south to the Savannah River of Georgia (Clarke 1981).

Habitat Ponds, canals and slow flowing rivers on sandy or muddy bottoms. It is most abundant in ponds near the sea coast. The host fish of the glochidia larvae is unknown although the habitat suggests an anadromous species, possibly the Alewife (Gaspereau).

Vulnerability Vulnerable to pollution or physical habitat alteration.

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INSECTS

Study of insects in New Brunswick has for the most part been practically oriented. Foresters and agronomists have devoted considerable effort to controlling the populations of a relatively small number of pest species on important timber and pulp trees as well as on commercial fruits and vegetables. Non-pests, including a number of major insect orders, have received comparatively little attention, and few publications have dealt specifically with their occurrence, distribution and habitats in the province.

For a brief period around the turn of the century, the Natural History Society of New Brunswick acted as a catalyst of interest in some of the more conspicuous insect groups. The lists of butterflies, moths and flies compiled and published by William McIntosh (1899a, b, c; 1901; 1903; 1905) were based on extensive collections and represented a partial fulfilment of one of the important, stated objectives of the society, namely the systematic inventory of the provincial fauna and flora. A sizeable collection of Hymenoptera (ants, wasps, bees) was made by another active member of the society, A.G. Leavitt, but no catalogue was published. Unfortunately, many of these early insect collections are now badly deteriorated and thus of little scientific or documentary value.

Through the recent studies of Lewis and Bennett (1977) and Thomas (1978, 1980a), the horseflies and deerflies (Tabanidae) are now one of the better known families of true flies (Order Diptera) in the province. Fifty-two species have been recorded, some of them common and widespread, others known only from a few specimens or a single locality. One species in the latter category, the deer fly Chrysops delicatulus, may prove to be vulnerable to habitat destruction.

This fly (see Pechuman (1981) for description and illustration) was first recorded for New Brunswick (locality unspecified) by McIntosh (1903), but was not reported again until 1979, when 4 females were collected in a Sphagnum bog about 5 km north of Lepreau, Charlotte Co. (Thomas 1980a). The natural history of the species at this locality is as yet unknown, but elsewhere, its larvae inhabit muddy streambanks in swampy or boggy areas (Teskey 1969; Pechuman 1981). Although C. delicatulus is at the northeastern limit of its range in New Brunswick, it is probably more widely distributed in suitable habitat in the south of the province than the single known locality would indicate (A.W. Thomas, pers. comm.).

The butterflies and moths (Order Lepidoptera) of New Brunswick are less well known than those of neighbouring Nova Scotia and Maine (Ferguson 1955; Brower 1974). Ferguson (1955) reported 69 species of butterflies and 789 species of "macro-moths" in Nova Scotia. A list of New Brunswick butterflies may be extracted from A Revised Check-List of the Butterflies and Skippers of Canada (Lepidoptera) by Gregory (1983), but there is no recent, comparable catalogue of New Brunswick moths. Since the mid-1960s, D.S. Christie, C. Majka and A.W. Thomas have actively collected butterflies in New Brunswick, and C. Majka is in the course of preparing a comprehensive treatment of this group in the province. Four butterflies are included in this report on the grounds of their restricted distribution and (potentially) vulnerable habitats. One moth, Ceratomia amyntor, is judged to be a vulnerable species on account of its presumed dependence on the American Elm, a tree whose survival in the province is in jeopardy. Other species known only from a single or a few collections/localities could perhaps be added to this list. In most cases, however, these species are undoubtedly more common or widespread than the collection data suggest. For example, the Eastern Pine Elfin (Incisalia niphon clarki), a medium-sized, dull-brown butterfly, is known from a total of 3 localities in Saint John, York

and Kent Counties, but suitable habitat (pine forest) is present in many other, under-collected areas of the province where the species may be expected to occur. In other cases, there is little data on the habitat of apparently rare species. The butterflies and moths referable to these categories are listed below, with the suggestion that they be considered as candidates for a future, revised list of vulnerable species. Nomenclature follows the Checklist of the Lepidoptera of America north of Mexico by Hodges et al. (1983). The common names are those used by Klots (1951) and Holland (1968).

Oeneis jutta ascerta Masters & Sorensen	Jutta Arctic
Clossiana titania grandis (Barnes & McDunnough)	Purple Lesser Fritillary
Charidryas nycteis nycteis (Doubleday)	Silvery Checkerspot
Polygonia satyrus neomarsyas dos Passos	Satyr Angle Wing
Feniseca tarquinius novascotiae McDunnough	Harvester
Harkenclenus titus titus (Fabricius)	Coral Hairstreak
Satyrium acadicum (Edwards)	Acadian Hairstreak
S. calanus falacer (Godart)	Banded Hairstreak
S. liparops strigosum (Harris)	Striped Hairstreak
Erora laetus (Edwards)	Early Hairstreak
Incisalia polia Cook & Watson	Hoary Elfin
I. niphon clarki Freeman	Eastern Pine Elfin
Everes comyntas (Godart)	Eastern Tailed Blue
Lycaeides argyrognomon aster (Edwards)	Northern Blue
L. a. empetri (Freeman)	Northern Blue
Artogeia virginiensis (Edwards)	West Virginia White
Amblyscirtes vialis (Edwards)	Roadside Skipper
Euphyes bimacula (Grote & Robinson)	Two Spotted Skipper
Hesperia sassacus Harris	Indian Skipper
Wallengrenia egeremet (Scudder)	Northern Broken Dash
Sphinx luscitiosa Clemens	Clemens' Hawkmoth

S. drupiferarum J.E. Smith	Wild Cherry Sphinx
Laothoe juglandis (J.E. Smith)	Walnut Sphinx
Amphion floridensis Clark	Nessus Sphinx
Automeris io (Fabricius)	Io Moth
Anisota virginiensis (Drury)	Pink Striped Oakworm

The case for protecting rare species of insects can be simply stated but not easily appreciated, much less acted upon. They should be protected for their own sakes. They are the product of many millenia of evolution and natural selection and cannot be "brought back" from extinction. Human interest obviously requires that crops, forests and human health and well-being be defended against harmful insects, but the number of species in this category is in a very small minority relative to the beneficial or at least innocuous species. Cultural bias is responsible in no small measure for the low esteem in which insects in general are often and unjustly held in our society (see Munroe (1977) for a discussion of this subject).

Rare insects in New Brunswick may be vulnerable, in some cases, to pesticide spraying, to the introduction of predators, or to other control programmes directed at, but not specific to pest species. Like any living organisms, they may also be vulnerable to destruction or modification of the plant and animal communities and physical environment which they inhabit. Only a few especially vulnerable habitats can be identified at present, but this is merely a reflection of our scant knowledge of New Brunswick insects. The most vulnerable species may well be those whose occurrence in the province is not yet known. Studies of the status of little known insect groups cannot be expected to keep pace with ongoing alteration of New Brunswick forests, bogs, salt and freshwater marshes and other natural ecosystems. The only thorough approach to protection, without

addressing the question of its compatibility with current economic imperatives, would be the preservation of sizeable and representative areas of all natural habitats in the province, particularly those which cannot or which only very slowly recover from disturbance.

SPECIES ACCOUNTS

Coenonympha inornata nipisiquit McDunnough Maritime (or Nepisiguit) Ringlet

Identification Refer to The Butterflies of North America by W.H. Howe (1975) p. 104 (*C. n. nipisiquit*, *C. tullia nipisiquit*)

Distribution (see Map 9). Endemic to salt marshes within the city limits of Bathurst. Colonies are known only from the Peters River marsh behind Youghall Beach and from near Carron Point on the east side of Bathurst Harbour. Repeated searches of apparently suitable coastal habitat from Campbellton east to Miscou Island and south to the Miramichi estuary have yielded no additional records (Brown 1955; Christie 1970; Thomas 1980b).

Five subspecies of *C. inornata* have been distinguished, some of them exhibiting considerable intergradation where their ranges overlap. Until very recently, *C. i. nipisiquit* has been geographically isolated (see below). It is also temporally isolated, meaning that the flight season does not overlap with that of any other subspecies of *C. inornata*. The species ranges from eastern British Columbia to Newfoundland and southward, from Montana to the Dakotas to the New England states. *Coenonympha inornata*, in turn, is part of a species complex (*C. tullia*) which is distributed throughout the northern and montane parts of the Holarctic region (Klots 1951). The taxonomic status and distribution of the Maritime Ringlet have been a matter of controversy in recent years, and a brief historical review of the subject is in order.

The subspecies *C. i. nipisiquit* was discovered and described in 1939 by J.H. McDunnough, who along with W.J. Brown collected a long series of specimens "on the salt marshes a few miles north of Bathurst" (McDunnough 1939; exact type locality not specified). Prior to this date, all populations of *C. inornata* were considered to produce a single, June-flying adult generation each year. The Bathurst population (*C. i. nipisiquit*) is single-brooded, but flies in late July and early August. Its earliest and latest recorded flight dates are July 27 (Thomas 1980b) and August 8 (Brown 1955).

An additional August- (and September-) flying population of C. inornata was discovered on the Thousand Islands in northern New York state in 1957, and rearing studies indicated that it did not derive from eggs laid by June-flying C. i. inornata, also present on the same islands (Brown 1961). On the basis of this evidence, some lepidopterists (e.g. Emmel 1975) considered the late-flying populations to belong to a separate species, C. nipisiquit, the Thousand Islands and Bathurst populations designated as C. n. heinemani and C. n. nipisiquit respectively. More recent evidence has contradicted the findings of Brown (1961), and Layberry et al. (1982) report that "the Nipisiquit [sic] Ringlet, formerly believed to be a separate species, is now considered to be only a partial second generation of the Inornate Ringlet".

While the latter statement may be an accurate assessment of the status of "C. n. heinemani", it is unproven and evidently incorrect in the case of the Bathurst population, whatever its assigned taxonomic rank (species or subspecies) (A.W. Thomas, pers. comm.). The nominate C. i. inornata first appeared in New Brunswick in the late 1970s through eastward and southward expansion of its range (Christie 1983). Until very recently, therefore, no June-flying population of C. inornata has been present in the province and the putative "partial second generation" at Bathurst must in fact be a distinct, single-brooded, August-flying population. An hypothesis to account for the singularly late emergence of C. i. nipisiquit has been advanced by Brown (1955) (see below under "Habitat").

Concurrent with its ongoing range expansion, C. i. inornata in some areas, although not yet in New Brunswick, is now producing a second generation of adults which fly from mid-August to early September (A.W. Thomas, pers. comm.; Layberry et al. 1982; Christie 1983). Should an August brood be produced in the Bathurst area, it is possible that the flight seasons of C. i. inornata and C. i. nipisiquit will overlap and that introgressive hybridization will occur.

Habitat Salt marsh, from the landward edge down to some of the lowest, wettest situations (D.C. Ferguson, excerpt of letter in Brown 1955). Flying adults have been found in greatest numbers in marsh vegetation dominated by Spartina alterniflora, Juncus balticus and Triglochin maritima (Christie 1970). Ferguson (loc. cit.) noted concentrations of adults around "spots where a species of low, brown colored marsh grass grows" [probably Juncus balticus and (or) J. gerardii, although these are not true grasses]. It is unclear why C. i. nipisiquit should be so

highly restricted in distribution, although Christie (1970) has noted that the marshes in which it occurs are different in aspect from those elsewhere along Chaleur Bay. This difference was attributed to the relative abundance of the dominant plant species rather than to variation in the overall composition of the vegetation.

The immature stages and larval food plants of C. i. nipisiquit are as yet unknown. In all other subspecies of C. inornata, the larvae feed on [true?] grasses (Gramineae) (Emmel 1975). Brown (1955) suggested two lines of investigation on the natural history of C. i. nipisiquit, both of which bear systematic pursuit:

"The very late emergence date and the fact that the habitat is flooded at spring tides by salt water suggest that the life history will be found to differ from that of the other tullia [inornata] in North America. [1] It may be found that the insect over-winters as an egg. This might account for the late date of emergence. [2] Another possibility is that the young larvae burrow into grass or sedge stems to evade the ill effects of salt water."

Vulnerability In danger of extinction, if its salt marsh habitat in the Bathurst area is destroyed or contaminated. Christie's (1970) assessment is apparently still valid:

"The best marshes...would not seem to be threatened by immediately foreseeable growth of the city. The only present development nearby is a continuous line of cottages along the beaches that protect the marshes from the sea. With all the beaches privately controlled, a second tier of cottages does not seem likely. A more possible danger to these insects might be a mosquito control program in the area [of the marshes]."

The Peters River salt marsh (within the city of Bathurst) has been proposed as an ecological reserve with the purpose of protecting this species and the Salt Marsh Copper (Epidemia dorcas dospassosi) (Wein 1975).

Hyllolycaena hyllus (Cramer) Bronze Copper

Identification Refer to The Butterflies of North America by W.H. Howe (1975) p. 312 (Lycaena hyllus, L. thoe).

Distribution (see Map 10). In New Brunswick, known only from wet meadows bordering on the Jolicure Lakes, Westmorland Co., where it was discovered in 1980 (Thomas 1981). This population is widely disjunct from the continuous range of the species, which extends from Quebec to Alberta and southward to New Jersey, Arkansas and Colorado.

Habitat Open, wet meadows. Two adult broods are produced, with numbers peaking in late June and in late August-early September (Layberry et al. 1982). The species over-winters as an egg. Larvae feed on docks (Rumex spp.) and knotweeds (Polygonum spp.) although the specific food plants near the Jolicure Lakes have not yet been determined.

Vulnerability Vulnerable to habitat alteration or destruction. A major change in the water level of the Jolicure Lakes could bring about the extirpation of this species in New Brunswick (A.W. Thomas, pers. comm.).

Epidemia dorcas dospassosi (McDunnough) Salt Marsh Copper

Identification Refer to The Butterflies of North America by W.H. Howe (1975) p. 314 (Lycaena dorcas dopassosi).

Distribution (see Map 11). Endemic, so far as is known, to coastal salt marshes in northeastern New Brunswick and the adjacent Gaspe Peninsula, Quebec (Thomas 1980b). The type specimens of E. d. dospassosi were collected by J.H. McDunnough and W.J. Brown at the same locality and time (Bathurst, early August, 1939) as those of the Maritime Ringlet (Coenonympha inornata nipisiquit (McDunnough 1940). Apart from the discovery of a colony at nearby Beresford in 1970 (Christie 1970), no additional localities for E. d. dospassosi were recorded until a 1979 survey by A.W. Thomas. At present, colonies are known in New Brunswick from Hay Island and Wishart Point, Northumberland Co. and at Beresford, Bathurst (three separate localities within the city limits), Village-des-Poiriers and Miscou Island, all in Gloucester Co. (Thomas 1980b; D.S. Christie, pers. comm.). Epidemia dorcas ranges from Alaska to Newfoundland and southward to Saskatchewan, Minnesota, Ohio and Maine.

Habitat Salt marsh. The colonies at Bathurst occur in vegetation dominated by Spartina alterniflora, Juncus balticus and Triglochin maritima (Christie 1970). McDunnough (1940) observed females ovipositing on an unidentified species of Potentilla. This was undoubtedly P. anserina, which occurs on the Bathurst marshes and all around the New Brunswick coast (Christie 1970). All subspecies of E. dorcas are single-brooded (Klots 1951).

Vulnerability Vulnerable to habitat alteration, destruction or contamination, although less so than the Maritime Ringlet, which is restricted in distribution to a single, small area.

The Peters River salt marsh within the city at Bathurst has been proposed as an ecological reserve with the purpose of protecting both the Salt Marsh Copper and Maritime Ringlet (Wein 1975).

Papilio brevicauda bretonensis McDunnough Short Tailed Swallowtail

Identification Refer to The Butterflies of North America by W.H. Howe (1975) p. 393.

Distribution (see Map 12). In New Brunswick, restricted to coastal localities in Restigouche, Gloucester, Northumberland and Kent Counties. Otherwise known only from coastal Cape Breton, Nova Scotia (Isnor 1981). Nominate P. b. brevicauda occurs in Newfoundland, southern Labrador and on Anticosti Island; P. gaspeensis is confined to the Gaspe Peninsula. The three subspecies of P. brevicanda are rather poorly distinguished and may form a cline (Klots 1951).

Habitat Open, coastal meadows and salt spray barrens. Larvae feed on various species of the plant family Umbelliferae, including Scotch Lovage (Ligusticum scothicum), Seaside Angelica (Angelica lucida) and Cow Parsnip (Heracleum lanatum). The Short Tailed Swallowtail is single-brooded, with adults flying from mid-June to late July. It is occasionally abundant in suitable habitat in New Brunswick, but numbers vary locally from year to year (C. Majka, pers. comm.; Ferguson 1955). This fluctuation is perhaps attributable in part to a periodic, local build-up of the population of parasitic wasps (Ferguson 1955).

Vulnerability May be vulnerable to development or burning of its coastal habitat.

Ceratomia amyntor (Geyer) Elm Sphinx Moth

Identification Refer to The Moth Book by W.J. Holland (1968) p. 47.

Distribution (not mapped). Distribution restricted by the occurrence of elm trees (Ulmus spp.), the principal larval food plant. In New Brunswick, C. amyntor has been recorded from Carleton, York, Sunbury, Charlotte and Saint John Counties (C. Majka, pers. comm.).

Habitat Elm trees. Ulmus americana is the only species which occurs naturally in New Brunswick (Hinds 1979). This moth has also been recorded less frequently on beech, cherry, birch and basswood trees (C. Majka, pers. comm.).

Vulnerability May face extirpation in New Brunswick as a result of the decline of the elm, Ulmus americana, due to Dutch elm disease. It is possible that the Elm Sphinx Moth will transfer successfully to other food plants.

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FISHES

There are 42 species of freshwater fishes native to New Brunswick, plus four introduced species (Gorham 1970), including anadromous (living mainly in salt water and spawning in freshwater) and catadromous (living mainly in freshwater and spawning in salt water) species. Of the fishes included in this report, McAllister and Gruchy (1977) consider the Shortnose Sturgeon (Acipenser brevirostrum) to be rare on a national level. Internationally the species is listed as endangered (United States Fish and Wildlife Service 1983) although the New Brunswick population does not seem threatened at the moment (Dadswell 1979). The Pygmy Smelt (Osmerus spectrum), confined to four lakes in Maine, New Brunswick and Quebec, has only recently been re-established as a valid species (Lanteigne and McAllister 1983). This fish would be a prime candidate for a future, revised list of rare species in Canada. Other potentially vulnerable species of New Brunswick fishes were identified according to their status in Gorham (1970), McAllister and Gruchy (1977) and Scott and Crossman (1973). Information on extra-New Brunswick distribution and on habitat has been taken from Scott and Crossman (1973).

The majority of fish studies in New Brunswick have concentrated on the sport and commercial species. Relatively little is known, therefore, of the distribution, ecology and behaviour of the non-food, non-sport species. It is difficult to assess the present status and distribution of these non-commercial fish and future studies may reveal them to be more common than is indicated here.

The Redbreast Sunfish (Lepomis auritus) may be a candidate for a future list of vulnerable species. Although not uncommon in southeastern New Brunswick, it occurs nowhere else in Canada (Scott

and Crossman 1973). It does not appear to be vulnerable at present to habitat destruction or deterioration and is little esteemed as a game fish.

McAllister and Gruchy (1977) cite habitat deterioration, introduction of exotic species, overfishing and dam construction as the main causes of extinction or serious population decline of native fish species in Canada. A list of important water pollutants in New Brunswick would include municipal sewage, wood products waste, the effluent of vegetable-processing plants, forest and agricultural pesticides and acid rain. Thermal pollution may occur locally, involving the heating of river water for industrial cooling.

Water pollution may have a direct (toxic) effect on fish or may act indirectly by inducing changes in the composition and abundance of aquatic vegetation and the invertebrate fauna. Increased bacterial activity (decomposition of sewage) in polluted water may result in serious depletion of dissolved oxygen downriver from towns and cities.

SPECIES ACCOUNTS

Acipenser brevirostrum Lesueur Shortnose Sturgeon

Identification Refer to Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (1973) p. 80.

Distribution (see Map 13). Anadromous. In Canada restricted to the lower Saint John River (Scott and Crossman 1973). Found in drainages of the Atlantic coast of North America from Big Lake George of the Saint John River drainage in Florida north to the Saint John River in Saint John, Kings, Queens, Sunbury and lower York Counties in southern New Brunswick.

Habitat The Saint John estuary extends inland from the mouth of the Bay of Fundy (Reversing Falls), 120 km to tidehead above Fredericton. There is partial mixing of inflowing saline water with outflowing fresh or brackish water at Reversing Falls (Dadswell 1979). Warm brackish regions of the estuary provide

summer habitat and feeding grounds. Spawning (May 15 to June 15) sites are chosen in the upper estuary, adjacent to deep, turbulent sections of the river. Wintering areas are in the estuarine and deep saline regions of the lower estuary (Dadswell 1979).

Vulnerability Considered a rare species on a national scale (McAllister and Gruchy 1977) and listed as endangered by the United States Fish and Wildlife Service (1983). Gorham and McAllister (1974) suggested that pollution of the Saint John River and the use of pesticides, which might affect the benthic fauna, the principle food of A. brevirostrum, may seriously affect the population in the Saint John River estuary. Recent studies, however, have shown that the Saint John River estuary contains an estimated 18,000 adult Shortnose Sturgeon, one of the largest single populations of this species on the coast of North America (Dadswell 1979). Dadswell (1979) suggests that this fish cannot be considered endangered in Canada as long as the Saint John estuary is protected from degradation and the population from overfishing.

Alosa aestivalis (Mitchill) Blueback Herring

Identification Refer to Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (1973) p. 119.

Distribution (see Map 14). In New Brunswick restricted to the lower Saint John River below Gagetown, the lower Kennebecasis (Gorham 1970), and the lower Miramichi (J.D. Martin, pers. comm.) Rivers. The only other sites at which this species is found in Canada are Bras d'Or Lake and Shubenacadie and Stewiacke Rivers, Nova Scotia. Occurs along the eastern seaboard of North America as far south as northern Florida (Scott and Crossman 1973).

Habitat An anadromous species spending most of its life in salt waters and returning to freshwater sometime in the spring to spawn.

Vulnerability Although the species is relatively abundant along the New England coast (Scott and Crossman 1973), and Gorham (1970) reports it common in the lower Saint John and Kennebecasis Rivers, McAllister and Gruchy (1977) include the species in their list of threatened and endangered Canadian fishes. The Blueback is caught commercially along with the Alewife (Alosa pseudoharengus) and is therefore potentially vulnerable to overfishing. Water pollution may also pose a threat. Further study is required to accurately assess the status of this species in New Brunswick.

Salmo salar Linnaeus Atlantic Salmon

Identification Refer to Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (1973) p. 193.

Distribution (Not mapped). Anadromous. Found in most of the larger New Brunswick rivers, including their tributaries and estuaries; also in many smaller rivers and streams. Landlocked populations are found in Grand Lake, Queens Co., Loch Lomond, Saint John Co., Magaguadavic Lake, York Co. and many other New Brunswick lakes (M. Dadswell, pers. comm.). Native to the North Atlantic Ocean, in the west ranging from Ungava Bay south to the Connecticut River and in the east from beyond the arctic circle to Portugal.

Habitat Underyearlings remain in shallow pebbly riffles of streams and move into deeper riffles with boulders during the parr stage (2-4 years). After the parr stage, smolt descend the rivers and spend from one to two years at sea before returning to their breeding streams. Most nesting depressions (redds) are built at the tail of pools on the upstream edge of a gravel bar where the water depth is decreasing and the water current is accelerating (Peterson 1978). Landlocked Salmon remain in freshwater throughout their lives and spawn in tributary streams.

Vulnerability Hatching of eggs is delayed or prevented if they are exposed to acid waters with a pH of 4.0-5.5 (Peterson et al. 1980). Susceptible to the use of pesticides and pollution of the home streams by the effluent from pulp and textile mills. Construction of hydro-electric dams, especially on tributaries, will decrease access to spawning grounds. Clearcutting and road building along streams tends to increase siltation and eliminate pools between riffles which constitute the best habitat for young Salmon. Introduced Coho Salmon (Oncorhynchus kisutch) may also present a threat through interspecific competition and the introduction of diseases and parasites (Martin and Dadswell 1983). One of the most serious threats to the continued survival of anadromous stocks is the commercial fishery off Greenland (Scott and Crossman 1973).

Salvelinus alpinus (Linnaeus) Arctic Char

Identification Refer to Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (1973) p. 201.

Distribution (see Map 15). Anadromous or freshwater. In New Brunswick landlocked in Walton Lake, Kings Co. and Upsalquitch Lake, Northumberland Co. (Gorham 1970). Arctic Char from

Quebec have been successfully introduced into First and Second Portage Lakes, Restigouche Co. (A. Madden, pers. comm.). The species is circumpolar in the northern hemisphere with landlocked populations occurring as far south as New England, the British Isles, and portions of Europe (Scott and Crossman 1973).

Habitat Landlocked Char are found in cold, deep, lakes. Spawning takes place from September to December over gravel or rocky shoals in lakes and deep pools in rivers.

Vulnerability Clearcutting or construction of dams on tributaries of the two lakes in the province where this fish occurs naturally may eliminate habitat or block access to spawning grounds. Introduction of Lake Trout (S. namaycush) may eliminate Arctic Char (M. Dadswell, pers. comm.). The effects of acid rain require assessment.

Osmerus spectrum Cope Pygmy Smelt

Identification Refer to The Pygmy Smelt, Osmerus spectrum Cope, 1870, a forgotten sibling species of eastern North American fish by J. Lanteigne and D.E. McAllister (1983). Distinguished from the sympatric Rainbow Smelt (O. mordax) (see Scott and Crossman 1973 p. 310) by the following charcters: higher gill raker counts, relatively larger eye, lower lateral scale counts and smaller maximum size.

Distribution (see Map 16). In New Brunswick, known only from Lake Utopia, Charlotte Co. Other natural populations are known from Heney Lake in southern Quebec and from Wilton Pond and Green Lake in Maine. This fish has also been introduced to some lakes in Quebec. Further study should increase the number of known localities (Lanteigne and McAllister 1983).

Habitat Freshwater lakes. The Pygmy Smelt is a planktivore throughout its life.

Vulnerability Difficult to assess. The Pygmy Smelt is known to occur naturally in only two lakes in Canada and should be protected from pollution, including acid precipitation, habitat deterioration, overfishing and introduction of competitors (Lanteigne and McAllister 1983).

Pimephales promelas Rafinesque Fathead Minnow

Identification Refer to Freshwater Fishes of Canada by W.B. Scott and E.J. Crossman (1973) p. 480.

Distribution (see Map 17). Freshwater. Known only from the Saint John River drainage near Edmundston in Madawaska Co. (Gorham 1970). Ranges through central North America, north to the Great Slave Lake drainage. New Brunswick forms the eastern limit of its range in Canada (Scott and Crossman 1973).

Habitat Occurs most commonly in still, mud-bottomed ponds and streams.

Vulnerability Difficult to assess without further study.

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AMPHIBIANS AND REPTILES

There are 17 species (or 16, depending on the taxonomy one follows) of amphibians and nine species of reptiles (including two marine turtles) in New Brunswick (Gorham 1970). The distribution of most species is fairly well known although large portions of central and northern New Brunswick remain unstudied. The Water Snake (Natrix sipedon) is suspected to occur but has never been collected in New Brunswick. Specimens have been taken very close to the New Brunswick border in Maine (Gorham 1973). The occurrence of the Four-toed Salamander (Hemidactylium scutatum) has only recently (May, 1983) been confirmed by a report from Fundy National Park (Woodley 1983).

In this document none of the reptiles known to breed in New Brunswick is considered rare or vulnerable. There are, however, several New Brunswick records of the Leatherback Turtle (Dermochelys coriacea) (Bleakney 1965; New Brunswick Museum files), a marine species breeding largely in tropical regions which is considered endangered worldwide (Pritchard 1982, but see Mrosovsky 1983).

We consider one New Brunswick species of amphibian, the Gray Treefrog (Hyla versicolor) to be particularly vulnerable to habitat loss. In New Brunswick the triploid species (form?) Ambystoma tremblayi of the Blue-spotted Salamander has been recorded only in the lower Saint John River valley (Cook and Gorham 1979). Although Isnor (1981), in reviewing the status of Nova Scotia amphibians, listed this species as vulnerable due to its limited distribution in that province, we have not included it here. Its taxonomic status is unsettled, but recognition of this triploid as a separate species is questionable (Cook and Gorham 1979; Bogart 1982).

Construction projects (dams, roads, industrial and residential development) and forest clear-cutting are the main causes of habitat destruction for amphibians and reptiles. Acid rain may change the pH of lakes and ponds, adversely affecting developmental rates and increasing mortality in larval amphibians (Pough and Wilson 1977; Schlichter 1981) and certain chemical insecticides may prove toxic to both larvae and adults of amphibians (Harri et al. 1979).

SPECIES ACCOUNTS

Hemidactylium scutatum (Schlegel) Four-toed Salamander

Identification Refer to The Amphibians and Reptiles of New Brunswick by S.W. Gorham (1970).

Distribution (see Map 18). In New Brunswick known only from a sphagnum bog about the margin of Marven Lake in Fundy National Park (Woodley 1983 and pers. comm.). This is apparently the only national park in Canada in which this species is found. Further searching should reveal the presence of this salamander at other localities in New Brunswick. The species has a scattered distribution over eastern and central North America from the Gulf of Mexico north to Ontario and Cape Breton, Nova Scotia (Conant 1975).

Habitat The terrestrial adults are usually associated with sphagnum bogs and their adjacent woodlands or the peaty margins of streams and lakes. The eggs are deposited in spring near water, usually in small cavities in the sphagnum moss or about grass roots. The larvae are aquatic (Conant 1975).

Vulnerability Difficult to assess.

Hyla versicolor Le Conte Gray Treefrog

Identification Refer to The Amphibians and Reptiles of New Brunswick by S.W. Gorham (1970).

Distribution (see Map 19). Information on this species in New Brunswick has been taken from McAlpine et al. (1980). The Gray Treefrog has a very restricted distribution in New Brunswick,

now known only from Barkers Point at the mouth of the Nashwaak River. Specimens had been collected previously at Lower St. Marys, about 4 km southeast of Barkers Point, but Gray Treefrogs apparently no longer exist at this site. The species is widely distributed in North America, ranging from New Brunswick, south to Florida and west to southern Manitoba and central Texas (Conant 1975). The New Brunswick population is isolated by roughly 100 km from the continuous range of the species and is therefore of considerable zoogeographic interest (Cook 1970, 1977).

Habitat During the breeding season the population at Barkers Point is located in a number of ponds in an overgrown abandoned gravel pit that occupies roughly 16 hectares. Calling males are found mainly on the perimeter of islands of vegetation and among stands of flooded willow at heights varying from water level to 2 m above. During post-breeding dispersal from the ponds, males call in trees from heights of up to 10 m. Neither eggs nor tadpoles have been found in New Brunswick.

Vulnerability Threatened with extirpation in New Brunswick through loss of habitat. The marsh and some surrounding woodland at Barkers Point should be preserved and further field studies carried out to gain a better understanding of the status and natural history of this species in New Brunswick. McAlpine (1984) suggested that protection for this species under the New Brunswick Endangered Species Act was warranted.

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BIRDS

Birds have been the object of more extensive field observation and study, both professional and amateur, than most groups of animals in New Brunswick. Certain areas of the province, especially the relatively inaccessible Central and Northern Highlands, have been less thoroughly surveyed than others. Definite nest or brood records are few in number or lacking for certain species thought to be regular breeders. On the whole, however, the distribution, abundance, breeding and seasonal status and habitat requirements of most species are quite well known. The Birds of New Brunswick by W.A. Squires, first published in 1952 and revised in 1976, presents a compilation of this information.

A vulnerable bird species is here considered to be one whose localized breeding distribution or low overall numbers in the province make it especially susceptible to disturbance or to loss or contamination of its habitat. This implies that specific action can be taken in many cases to protect vulnerable species through habitat conservation or the safeguarding of particular nest sites.

Fragmentation and alteration of the natural (pre-settlement) forest cover of New Brunswick have not been detrimental to all bird species. Forest cutting, agriculture and subsequent land abandonment created additional or new habitat for birds of open grassland, as well as for those of early successional forest and forest edges (see Christie (1980) for an expanded discussion of this subject). Some of the species favored by these developments, the Robin and Savannah Sparrow among others, clearly bred within the geographic area of the province prior to the arrival of European settlers. Others, such as the Upland Sandpiper and Eastern Meadowlark, are presumed to have followed in the wake of settlement, as they are confined in New Brunswick to man-created habitats. Inasmuch as their extremely small, but now well-established breeding populations are vulnerable to

disturbance or changing agricultural practices, some birds in the latter category, notably the two species mentioned, may be considered to meet the criteria of vulnerability described above.

The starting point for the identification of vulnerable birds was a list of all species known to breed regularly in the province. A "short list" of uncommon and (or) localized birds was then compiled according to estimates of actual population numbers. This included species with fewer than an estimated 500 breeding pairs in New Brunswick or with 90% or more of the provincial population concentrated at fewer than 25 locations or colonies (A.J. Erskine, unpublished estimates). Application of the vulnerability criteria resulted in a final list of 23 species. These may be grouped, with few exceptions, by specific, vulnerable habitats. (Species designated below by an asterisk are not included in the final list but may be considered as candidates for a future, revised version. The available nest and sight records of these birds convey a picture either of sporadic breeding or of uncertainty concerning the size and distribution of their current populations in the province).

1. Freshwater marshes (various types)

Virginia Rail	Sedge Wren
Yellow Rail	* Green-backed Heron
Black Tern	* Least Bittern
Marsh Wren	

The Canadian Wildlife Service and Ducks Unlimited have created many artificial wetland impoundments for waterfowl. These areas may well provide additional habitat for some or all of these species.

2. Woodland lakes

Common Loon

3. Mature woodland

Hooded Merganser (floodplain forest is primary nest habitat.)
Pileated Woodpecker (climax deciduous or mixed forest.)
* Whip-poor-will (has also nested in young, second-growth stands in New Brunswick.)
* Great Crested Flycatcher

4. Fields, pastures, forest edges (subject to habitat change.)

Upland Sandpiper
Eastern Bluebird
* Loggerhead Shrike
Eastern Meadowlark
Vesper Sparrow

5. Salt marsh

Willet

6. Coastal beaches

Piping Plover (sand beach.)
Semipalmated Plover (gravel or cobble beach.)

7. Coastal islands (in the Grand Manan archipelago)

Leach's Storm-Petrel
Razorbill
Common Murre
Atlantic Puffin

These islands may be considered as vulnerable, rare habitats in that they provide safe (predator-free) nesting sites within commuting distance of suitable feeding areas (A.J. Erskine, pers. comm.). Disturbance, egging and overshooting in the past caused drastic fluctuations, decline or local extirpation of the breeding population of a number of pelagic seabird species in this area. Machias Seal Island, approximately 20 km southwest of Grand Manan, is a migratory bird sanctuary. It is the site of the only New Brunswick colonies of the Atlantic Puffin and Razorbill and of the largest provincial colony of Arctic Terns.

Gannets nested at Gannet Rock, south of Grand Manan, until about 1871 (Fisher and Lockley 1954, p. 82), but have not bred successfully south of the Gulf of St. Lawrence in this century (Brown et al. 1975). Nesting was attempted, without success, at Kent Island in 1974 (Squires 1976) and on White Horse Island in 1977, 1978 and 1979 (Gaskin and Smith 1979). The Great Cormorant has had a similar history in the outer Bay of Fundy. The species bred formerly on White Horse Island (Tufts and Townsend 1924), Grand Manan and at Mace's Bay (Chamberlain 1882; Squires 1976), but was apparently extirpated before 1930. Recently, however, Great Cormorants have been reported nesting near Isle au Haut on the Maine coast (Townsend 1983) and are re-appearing as a summer bird in the Bay of Fundy (Christie 1983b). The status of both the Gannet and Great Cormorant should be closely

monitored in this area with a view to protecting any nest sites that may be established. Both species are prime candidates for inclusion in a future list of vulnerable New Brunswick birds.

At present, oil pollution poses a serious potential threat to both pelagic and inshore seabirds in the outer Bay of Fundy. An oil slick of unknown origin entered the Bay in the winter of 1971 and was responsible for the death of hundreds of birds, including scoters, Common Eider, Oldsquaw, Brant and Razorbill (Squires 1976). The consequences of a major spill during the breeding season or during fall migration, when enormous numbers of migrant gulls, terns and phalaropes pass through the region (see Braune and Gaskin 1982; Christie 1983a), would clearly be catastrophic (Gaskin and Smith 1979). It has been estimated that much of the Quoddy region (comprising Passamaquoddy Bay, the Deer Island archipelago, Campobello Island, the Wolves, and all coastal waters from Point Lepreau to West Quoddy Head) would be contaminated within a week, should oil be spilled in Head Harbour Passage (Loucks et al., in Trites and Garrett 1983).

A synopsis of vulnerable bird habitats in the province would be incomplete without mention of the extensive mudflats of the upper Bay of Fundy. Although relatively unimportant as a habitat for resident, breeding birds, the Grande Anse (Westmorland Co.), Mary's Point (Albert Co.) and numerous smaller mudflats are critically important feeding and nesting areas for a number of shorebird species during the post-breeding, late summer and early fall migration. For the Semipalmated Sandpiper, the most abundant species, Mary's Point is the most important such "staging area" in eastern North America (Morrison 1976). The shorebirds feed on the extremely high densities of mudflat invertebrates, especially the burrowing amphipod Corophium volutator (Pallas), which in North America is known only from the Bay of Fundy and Maine coast (see Hicklin and Smith 1979). Having

accumulated substantial reserves of energy-rich fat, the birds embark directly from the Bay of Fundy on a non-stop, overseas flight to their winter range in South America (McNeil and Cadieux 1972).

The full effects of a major tidal barrage on this ecosystem cannot be predicted with certainty. The likely effects on the physical environment include changes in tidal amplitude, sedimentation patterns, water salinity and ice development. Such changes have the potential to seriously reduce the biological diversity and productivity of large areas of intertidal mudflat. This, in turn, could affect major segments of the populations of certain North American shorebirds (Morrison 1976).

Information on the habitat requirements and current breeding status of certain birds of prey in the province is too scant to allow an assessment of vulnerability. These species, listed below, should be afforded strict protection wherever they are found nesting:

Cooper's Hawk	Long-eared Owl
Red-shouldered Hawk	Boreal Owl

Also excluded from consideration for the vulnerable species list are birds whose breeding distribution approaches, but does not consistently include New Brunswick. Sporadic breeding records are to be expected somewhat beyond the margin of a species' normal range, although these cases may sometimes represent the first stages of a significant range extension (see Christie 1980).

The following list includes species which have been known to nest only once or sporadically in the province, as well as those which have recently established small breeding populations through eastward or northeastward expansion of their range. None are considered to be vulnerable species in the present context.

Horned Grebe	Northern Hawk-Owl
Gadwall	Northern Rough-winged Swallow
Northern Shoveler	House Wren
Redhead	Northern Mockingbird
Least Sandpiper	Brown Thrasher
Laughing Gull	Northern Cardinal
Roseate Tern	Indigo Bunting
Mourning Dove	Field Sprarrow
Yellow-billed Cuckoo	

The Bald Eagle, Osprey and Peregrine Falcon are protected in New Brunswick by the Endangered Species Act. Their status in the province has come under careful scrutiny by Stocek and Pearce (1978a, 1978b, 1981). The Osprey is evidently neither rare nor restricted in distribution in the province at present and shows no sign of a decline in breeding numbers (R.F. Stocek, pers. comm.). It is not considered here to be a particularly vulnerable species. The Bald Eagle is judged to be vulnerable to shooting and disturbance, given the very small number of breeding pairs in the province. The same may be true of the Peregrine Falcon, if current attempts at re-introduction prove to be successful.

In the preparation of the vulnerable species accounts, a number of key references have been drawn upon freely for information on distribution and habitat: Squires (1952, 1976), the American Ornithologists' Union (1983) Checklist of North American Birds, Palmer (1962), Godfrey (1966) and Tufts (1973). Species' nomenclature follows the A.O.U. checklist. The "Blue List" of the periodical American Birds has been cited in some cases. This annual list was instituted in 1972 with the intention of establishing an "early warning system" for species "showing clear, recent signs of population decline in all or a major part of their range" (Tate and Tate 1982, p. 126). Squires (1976) has been followed in designating the abundance

of each species as "uncommon", "rare" or "very rare" in New Brunswick.

The distribution maps of vulnerable bird species show only breeding localities and have been prepared from the data in the Maritime Nest Records Scheme (Canadian Wildlife Service, Sackville, N.B.) and the sight record files of the Natural Science Department at the New Brunswick Museum. With the exception of the Leach's Storm-Petrel and Peregrine Falcon, records of breeding prior to 1960 have not been mapped. Each (solid) dot refers to a documented nest or brood record. The maps of the Eastern Bluebird, Eastern Meadowlark and Vesper Sparrow also include records of presumed breeding (shown as empty circles (o)) as indicated by the results of the Breeding Bird Surveys (N.B. Museum files). Without this supplementary data, the maps of the latter two species would be conspicuously incomplete.

SPECIES ACCOUNTS

Gavia immer (Brunnich) Common Loon

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 9.

Distribution (see Map 20). An uncommon summer resident on inland lakes and rivers. Inhabits coast throughout the year. Breeds from Alaska to Greenland and Iceland and south to northern California, Ohio and Maine. Winters on Pacific and Atlantic coasts of North America south to Mexico and (uncommonly) on the lower Great Lakes; also winters on the coasts of western Europe.

Habitat In spring, summer and fall, adults inhabit freshwater lakes and slow-flowing rivers. The nest typically consists of a few aquatic plants placed together at the water's edge or on floating debris. In winter, adults inhabit seacoast or open freshwater near the coast. Immatures are seldom found in freshwater and tend to frequent coastal inshore salt waters throughout the year.

Vulnerability Vulnerable to disturbance during the breeding season, especially by recreational power boats. Elsewhere in Canada, eggs taken from Loons nesting on polluted lakes have been found to contain residues of DDE, PCBs and mercury, although the effects of these contaminants or Loon reproductive success are unknown (Vermeer and Peakall 1979). Acid precipitation is probably an important threat, since it upsets or destroys the food chain of unbuffered freshwater lakes.

Oceanodroma leucorhoa (Vieillot) Leach's Storm-Petrel

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 25.

Distribution (see Map 21). Comes to land only to breed. In New Brunswick, nests only on a number of small coastal islands in the Grand Manan archipelago. Pettingill (1939) reported colonies on Machias Seal Island, Kent Is., Outer Wood Is., Western Green Is. and White Head Is., but apart from the studies of C.E. Huntingdon on Kent Is. (in Squires (1976) p. 22), no recent census has been made of this species in the Bay of Fundy. Adults have been found on the New Brunswick breeding colonies as early as April 8 and young as late as late December. O. l. leucorhoa breeds locally in the north Pacific (northern Japan, Aleutian Islands), in the north Atlantic on scattered coastal islands from southern Labrador to northern New England and in the northern British Isles.

Habitat Open ocean. Colonial during the breeding season and inhabiting both grassy and wooded coastal islands. Nest burrows are excavated in turfy soil.

Vulnerability Vulnerable to the introduction of terrestrial predators, especially foxes, dogs, cats and rats, to its island breeding sites. Oil spills pose a serious potential threat.

Nycticorax nycticorax (Linnaeus) Black-crowned Night-Heron

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 40.

Distribution (see Map 22). An uncommon summer resident, accidental in December and January. Breeds in scattered colonies in northern New Brunswick and at the following localities on the Bay of Fundy coast: Nantucket Island, near Grand Manan; on a small island in Head Harbour Passage (Townsend 1983) and Red Head Marsh (Christie 1983b) in the city of Saint John.

Irregular sightings of adults and immatures over the last 10 years at Saints Rest Marsh, also in Saint John, suggest the existence of an additional, small colony in this area (J.G. Wilson, pers. comm.). One large colony near Inkerman, Gloucester Co., accounts for 95% of the known New Brunswick population of this species (A.J. Erskine, pers. comm.). During migration, the Black-crowned Night-Heron is regularly observed throughout the province. N. n. hoactli (Gmelin) breeds from Washington east along the southern part of the Prairie provinces, southern Ontario and Quebec to New Brunswick, south as far as southern South America. (N. n. nycticorax breeds widely in Europe and Asia.)

Habitat Salt and freshwater marshes, tidal estuaries, mud flats, edges of lakes, ponds and sluggish streams, sometimes fields. Colonial in breeding season. Roosts and nests in trees. Nest of sticks (Godfrey 1966).

Vulnerability Vulnerable to disturbance and local pollution or overfishing. Included in the annual Blue List of American Birds from 1972 through 1981 (Tate 1981). In 1982 it was removed from the formal Blue List and categorized as a species warranting special concern on the grounds that it shows "continued signs of recovery, but...has not yet begun returning to areas from which it was extirpated in the last ten years" (Tate and Tate 1982, p. 129).

Lophodytes cucullatus (Linnaeus) Hooded Merganser

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 82.

Distribution (see Map 23). A rare summer resident, very rare in winter on open water. Since 1960, has nested at the following localities: Kilmarnock Marsh, Carleton Co.; Hampton Marsh, Kings Co.; floodplain and islands of the Saint John River in Sunbury Co.; Newcastle Creek, near Minto, Queen's Co.; California Lake, Northumberland Co.; Eel River Bar, Restigouche Co. May also breed at Coronary Lake in Charlotte Co. (J.G. Wilson, pers. comm.). Breeds from southern coastal Alaska and central British Columbia eastward in forested regions to New Brunswick and southern Nova Scotia, locally south to Oregon, Nebraska and the Gulf states. Winters from southern British Columbia, the Great Lakes and Massachusetts south to the Gulf coast.

Habitat Freshwater ponds, lakes and rivers in woodland. In New Brunswick, largely restricted for nesting to tree cavities in floodplain forest, but will also use nest boxes.

Vulnerability Vulnerable to loss of habitat through forest cutting. Continued provision of nest boxes and habitat protection offer a means of maintaining or increasing the small resident population of this species.

Haliaeetus leucocephalus (Linnaeus) Bald Eagle

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 96.

Distribution (see Map 24). Two subspecies of the Bald Eagle occur in New Brunswick: H. l. alascanus (Townsend) as a breeding bird and uncommon year-round resident and H. l. leucocephalus as a non-breeding summer visitor. Eagles wintering in New Brunswick concentrate along the coastline of Charlotte Co. and the lower Saint John River. In a study conducted from 1974 to 1980, Stocek and Pearce (1981) found 19 occupied nest sites in the province, although no more than 12 of these were active in any one year. With the exception of a site on the Tabusintac River, Northumberland Co., all located nests were confined to southwestern New Brunswick, between the estuary of the Saint John River and the Maine (U.S.A.) border. An additional active nest has been found at Stoney Creek, Albert Co. (D.S. Christie, pers. comm.). H. l. alascanus breeds from Alaska, the northern part of the Prairie provinces, central Ontario and Quebec to Newfoundland, south to Oregon, the Great Lakes states and Maryland. Winters from Alaska and southern Canada to the southern limit of its breeding range. H. l. leucocephalus breeds across the southern United States, wanders north to southern Canada during the summer months, and winters within its breeding range.

Habitat The vicinity of lakes, rivers and seacoasts. Nests usually constructed near the top of a dominant tree in the forest or in a large, solitary tree on intervale land (Stocek and Pearce 1981). Cliff-nesting Bald Eagles, although known elsewhere, have not been reported in New Brunswick in recent years.

Vulnerability Vulnerable to shooting and disturbance of nest sites. Considered an endangered species both nationally (Godfrey 1970) and provincially, the Bald Eagle is protected by the New Brunswick Endangered Species Act. The primary cause of population decline throughout its range has been identified as the persistent chlorinated hydrocarbon pesticides, particularly DDE. There is evidence that high levels of DDE and PCBs have occurred in the eggs of both subspecies in Canada (Stocek and Pearce 1978b). Despite a decline in the southern subspecies, H. l. leucocephalus, in the Saint John estuary and central New

Brunswick, the breeding population of H. l. alascanus appears to be quite stable at approximately 12 pairs (R.F. Stocek, pers. comm.).

Falco peregrinus Tunstall Peregrine Falcon

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 102.

Distribution (see Map 25). A rare transient throughout the year (Stocek and Pearce 1978a). Nested formerly on cliffs between Fish Head and Seven Days Work on Grand Manan and near Matthew's Head in Fundy National Park (see Stocek 1974). Hearsay reports of breeding included sites near St. Martin's, Saint John Co., (Chamberlain 1882) and on Deer Island (Boardman 1903). There is no evidence that the Peregrine still breeds in the Atlantic provinces (Stocek 1974). However, the Canadian Wildlife Service is currently attempting to re-establish a breeding population of Peregrine Falcons in eastern Canada. Birds reared in captivity were released in July, 1982, and again in the summer of 1983, from a cliff site near Point Wolfe, Fundy National Park, Albert Co., New Brunswick as well as at Cape d'Or, Cumberland Co., Nova Scotia.

During spring and fall, migrating Peregrines are seen most frequently along the lower Saint John River valley, the Bay of Fundy coastline and in the Grand Manan archipelago. Formerly worldwide in distribution, the Peregrine is now greatly reduced in numbers and unknown in many areas where it formerly nested. The North American breeding populations, with the exception of those on the Queen Charlotte Islands, are designated as F. p. anatum Bonaparte. This subspecies winters from southern Canada to South America.

Habitat Open country, especially in the vicinity of coastal and inland cliffs, often about seabird colonies or shores and marshes frequented by shorebirds and waterfowl (Godfrey 1966).

Vulnerability Difficult to assess. Nest sites, if established, may be vulnerable to disturbance. Considered an endangered species nationally (Godfrey 1970) and internationally (Snow 1972), the Peregrine Falcon is protected in New Brunswick by the Endangered Species Act. The demonstrated sub-lethal effects of chlorinated hydrocarbon pesticides such as DDT are considered responsible for the major decline in Peregrine numbers (Fyfe et al. 1976).

Rallus limicola Vieillot Virginia Rail

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 122.

Distribution (see Map 26). An uncommon summer resident. Since 1960, has been reported breeding at the following localities: Germantown, Albert Co.; Darlings Island, Kings Co.; Oromocto Flats, Sunbury Co.; Midgic and Jolicure area, Westmorland Co. Probably bred at Kingston Lake, Kings Co. in the early 1970's (J. G. Wilson, pers. comm.). Breeds in southern Canada from British Columbia to Nova Scotia and south to southern South America. The North American populations are designated as R. l. limicola, which breeds as far south as California, Kansas and Maryland (rarely in the Gulf states) and winters south to Central America.

Habitat Restricted to relatively fertile freshwater marshes with cattail, bulrush or sedge vegetation, particularly those with less open water than waterfowl habitat (A.J. Erskine, pers. comm.).

Vulnerability Vulnerable to loss of habitat.

Coturnicops noveboracensis (Gmelin) Yellow Rail

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 124.

Distribution (see Map 27). A very rare summer resident. In recent times, has nested only in the Midgic area, Westmorland Co. Breeds locally from Alberta and southern Mackenzie District to New Brunswick, south to North Dakota, the Great Lakes and New England states; also in eastern California.

Habitat Restricted to wet meadows and similar shallow marshes with low grassy vegetation (A.J. Erskine, pers. comm.).

Vulnerability Vulnerable to loss of habitat, especially on account of its restricted distribution and very low numbers (A.J. Erskine, pers. comm.).

Charadrius semipalmatus Bonaparte Semipalmated Plover

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 132.

Distribution (see Map 28). A rare summer resident, common transient during fall migration. Has nested in the Bay of Fundy at Waterside and at the mouth of the Upper Salmon River (Fundy National Park) in Albert Co., at the mouth of Goose Creek in Saint John Co. and at Castalia on Grand Manan. Breeds from the southern part of the Arctic archipelago south to northern British Columbia and the northern Prairie provinces; along the coasts of northern Ontario, Quebec-Labrador, Newfoundland, Nova Scotia, Prince Edward Island and New Brunswick. Winters from California and South Carolina south to Chile and Argentina.

Habitat Beaches, fresh and salt mud flats or flat open margins of lakes, streams and rivers. Nest consists of a depression made in sand, gravel, moss or dead seaweed along sand dunes, beaches or sparsely vegetated low gravel ridges (Godfrey 1966).

Vulnerability Vulnerable to disturbance, especially through recreational use of beaches during the nesting season; also vulnerable to habitat destruction as, for example, by gravel removal for road-building or other purposes.

Charadrius melodus Ord Piping Plover

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 132.

Distribution (see Map 29). An uncommon summer resident and transient. Breeds along the east coast of the province from Miscou Island, Gloucester Co., to the Buctouche Bar, Kent Co., and on the north coast at Beresford, Gloucester Co. The first breeding in the Bay of Fundy was recorded at Waterside in 1981 by H.P. Barkhouse (Maritime Nest Records Scheme, CWS). C. m. melodus breeds on coastal beaches from the Gulf of St. Lawrence south to Virginia and winters from South Carolina to Florida. Cairns and McLaren (1980) estimated that "at most 910 pairs of Piping Plovers now nest on the Atlantic coast...". C. m. circumcinctus (Ridgway) breeds locally from southern Alberta to southern Ontario, south to South Dakota and the southern shores of Lakes Michigan and Erie; winters on the coast of the Gulf of Mexico.

Habitat C. m. melodus nests exclusively on sandy beaches along the seashore, especially in areas overwashed by past storms and not yet recolonized by dune vegetation (Cairns and McLaren 1980). C. m. circumcinctus nests on the shores of inland lakes and sloughs. The nest is a shallow hollow in the sand, unlined, or lined with shell fragments (Cairns 1982).

Vulnerability Vulnerable to disturbance during nesting season. Actual or potential nesting sites are in some cases being seriously degraded by the use of all-terrain vehicles. The Piping Plover is considered a threatened species by the Committee on the Status of Endangered Wildlife in Canada (Ouellet 1979). The breeding areas, as well as the birds themselves, should be protected during the nesting season in New Brunswick.

Bartramia longicauda (Bechstein) Upland Sandpiper

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 145.

Distribution (see Map 30). A rare summer resident, known to breed only in fields near Salisbury, Westmorland Co. (An adult Upland Sandpiper exhibiting nesting behavior was observed by J.G. Wilson on June 19, 1971 in a short-grass field at Pennfield, Charlotte Co. No nest was found, however, and the species was not seen again in this area in subsequent years). Breeds locally from southern Alaska, Alberta, central Saskatchewan and southern Manitoba to southeastern Canada, south to Oregon, Missouri and Maryland. Winters in southern South America.

Habitat Open grassy uplands, hayfields and pasturelands. Nests are located in a depression in the ground and hidden by low vegetation.

Vulnerability Vulnerable throughout its range to habitat disturbance or alteration. Included in the annual Blue List of American Birds since 1975 (Tate 1981, Tate and Tate 1982).

Catoptrophorus semipalmatus (Gmelin) Willet

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 148.

Distribution (see Map 31). A rare summer resident in New Brunswick. Known to breed only in the southern part of the Northumberland Strait and at the Ram Pasture Marsh in the upper Bay of Fundy. Willets were hunted close to extinction earlier in the century, but under protection have showed a strong recovery. Nesting birds were first noted in New Brunswick in 1966 at Baie Verte, Westmorland Co., part of a general, recent expansion of the species' breeding range in the Maritime provinces (Erskine 1967). The two subspecies of the Willet are geographically isolated: C. s. semipalmatus breeds in coastal localities in Nova Scotia and eastern New Brunswick and locally from Maine to

Mexico; winters from the Gulf Coast to northern South America. C. s. inornatus (Brewster) breeds in the western interior from Oregon, Idaho and the southern Prairie provinces, south to California, Colorado and South Dakota.

Habitat In the east, inhabits salt marshes and coastal beaches. Nest is placed on the ground, usually well concealed among low-growing bushes in open fields or bushy pastures and usually, if not always, in the vicinity of salt marshes (Tufts 1973, p. 199).

Vulnerability Vulnerable to disturbance or habitat destruction, especially by dyking.

Larus delawarensis Ord Ring-billed Gull

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 181.

Distribution (see Map 32). An uncommon summer and winter resident, common transient in spring and fall. Until recently, the only known nesting site was at Bathurst Harbour, Gloucester Co., where a small colony, discovered in 1965, had increased to 40 nesting pairs in 1972 (Squires 1976). Two additional colonies were discovered in 1983: one at Tabusintac Gully, Northumberland Co.; the other at Dalhousie, Restigouche Co. (see Christie 1983). In western North America, the Ring-bill breeds in the Prairie provinces north to Lake Athabaska, south to California and Colorado. The eastern North American breeding range is markedly discontinuous, including scattered localities on Lake Superior, the southeast coast of James Bay, southern Ontario and Quebec, New York, the north shore of the Gulf of St. Lawrence, northeastern New Brunswick, Melville Inlet in Labrador and eastern Newfoundland. In recent years, the Ring-bill has shown a general increase in numbers east of the Great Lakes.

Habitat Seacoast, estuaries, rivers and lakes; also garbage dumps, recently plowed fields and urban areas. Colonial in breeding season. Nests on the ground on islands or spits on the seacoast or on large lakes. The colony at Dalhousie occupies a slash pile near the pulp mill. (The birds apparently relocated here recently from another site nearby, although it is not known if the move was precipitated by disturbance).

Vulnerability Tentatively included as a vulnerable species on the grounds that the entire known breeding population in the province is restricted to only three nest sites. May be vulnerable to disturbance at nesting colonies.

Chlidonias niger (Linnaeus) Black Tern

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 194.

Distribution (see Map 33). An uncommon summer resident, first reported nesting in New Brunswick in 1937 (Squires 1976). Breeding colonies have been recorded at the following localities: Big Timber Lake and the mouth of Portobello Creek, Sunbury Co.; Hog Island at the foot of Washademoak Lake, Queens Co.; Bloomfield, Kings Co. (no evidence of breeding at this site since 1978 (J.G. Wilson, pers. comm.)); Germantown, Albert Co.; Paunchy Lake, Westmorland Co. The North American populations, designated as C. n. surinamensis (Gmelin), breed across southern Canada from British Columbia to New Brunswick and south to California, Nebraska, Pennsylvania and Maine. Winters on coasts of South America.

Habitat Freshwater marshes in which floating vegetation mats are interspersed with open water. Colonial in breeding season. Nest usually consists of a hollow in a floating vegetation mat.

Vulnerability Vulnerable to habitat disturbance or destruction. Included in the annual Blue List of American Birds since 1978 as it appears to show a "continuing decline in all areas east of the Rockies" (Tate and Tate 1982).

Alca torda Linnaeus Razorbill

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 196.

Distribution (see Map 34). A rare summer resident, known to nest only at Machias Seal Island. Common in winter on the Bay of Fundy. A fairly large colony, numbering approximately 100 pairs, existed formerly at Yellow Murr Ledge south of Grand Manan (Pettingill 1939; Squires 1976). Breeds on coastal western Greenland, southeastern Baffin Island and from the middle Labrador coast south to Nova Scotia, New Brunswick and Maine; also on Iceland and in coastal northern Europe. Western Atlantic populations winter as far south as the Carolinas.

Habitat Open ocean. Colonial during the breeding season and inhabiting rocky coastal islands without terrestrial predators. No nest is constructed. Eggs are laid on bare rock in crevices or under boulders or overhangs.

Vulnerability Vulnerable to disturbance and to introduction of terrestrial predators to its island nest sites. Oil spills pose a serious potential threat.

Uria aalge (Pontoppidan) Common Murre

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 196.

Distribution (see Map 35). A rare year-round resident on the New Brunswick coast. Known to nest only at Yellow Murr Ledge off Grand Manan, but is also frequently observed in summer at Machias Seal Island. U. a. aalge breeds on coastal western Greenland and from the middle Labrador coast south to Nova Scotia and New Brunswick; also on the coast of Iceland, northern British Isles and central Norway. Eastern North American populations winter offshore from northern Newfoundland as far south as New Jersey. Other subspecies breed in the north Pacific.

Habitat Open ocean. Colonial during the breeding season and inhabiting rocky coastal islands which lack terrestrial predators. Eggs are laid on bare rock on cliff ledges, flat rock or in crevices.

Vulnerability Vulnerable to disturbance and to introduction of predators to its island nest sites. Oil spills pose a serious potential threat.

Fratercula arctica (Linnaeus) Atlantic Puffin

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 203.

Distribution (see Map 36). In New Brunswick, known to nest only at Machias Seal Island, where there were an estimated 900 pairs in 1974 (Nettleship and Parker, in Brown et al. 1975). Otherwise, a rare year-round resident near mouth of Bay of Fundy. Breeds on the coast of western Greenland and along the Atlantic coast from middle Labrador to southern Nova Scotia, New Brunswick and Matinicus Rock on the coast of Maine; also in northern Europe. The eastern North American breeding populations are designated as F. a. arctica.

Habitat Open ocean. Colonial during the breeding season and inhabiting rocky coastal islands which lack terrestrial predators. Nests at the end of an excavated burrow in turfy soil, also in rock crevices or under boulders.

Vulnerability Vulnerable to disturbance and to introduction of terrestrial predators to its island nest sites. Oil spills pose a serious potential threat.

Dryocopus pileatus (Linnaeus) Pileated Woodpecker

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 240.

Distribution (see Map 37). An uncommon year-round resident. May be found in suitable habitat throughout the province. Nest records are relatively few and do not adequately reflect the entire provincial breeding range. Breeds in the forested areas of Canada from the Yukon and British Columbia to Cape Breton and south to the southern United States. D. p. abieticola (Bangs), to which the New Brunswick population may be assigned, does not breed on the west coast or in the extreme southern United States.

Habitat Restricted to relatively extensive tracts of mature mixed or hardwood forest containing standing dead or decaying trees. Nest cavities usually excavated in dead trees at heights of fifteen to seventy feet.

Vulnerability Vulnerable to loss or fragmentation of habitat. Clear cutting of mature forests and short rotation forestry methods are probably detrimental to this species.

Cistothorus palustris (Wilson) Marsh Wren

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 289.

Distribution (see Map 38). A rare summer resident. Has nested in the Midgic marshes, Westmorland Co., the Red Head Marsh, Saint John Co. and at Kingston Lake, Kings Co. Suspected to breed also at the Germantown marsh, Albert Co. and the Timber Lakes, near McGowans Corner, Sunbury Co. (D.S. Christie, pers. comm.). Breeds from Vancouver Island to southern New Brunswick and south to California, Mexico and the Gulf states. Numerous subspecies have been described, of which only T. p. dissaeptus (Bangs) breeds in New Brunswick. This subspecies winters mainly in the Gulf states but wanders casually north as far as southern Ontario.

Habitat Loosely colonial in breeding season and found deep within shallow water marshes with cattail and bulrush vegetation. Large ball-shaped nest of marsh vegetation is attached to upright plant stems. Several dummy nests may be constructed.

Vulnerability Vulnerable to disturbance or destruction of marsh habitat.

Cistothorus platensis (Latham) Sedge Wren

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 290.

Distribution (see Map 39). A rare summer resident. Known to nest only near Midgic and Jolicure, Westmorland Co., although another population, presumably breeding, has been reported at Kingston Lake, Kings Co. (but see below). Sight records have been submitted for only three other counties: Albert, Kent and York. C. p. stellaris (Naumann) breeds from southern Saskatchewan to eastern New Brunswick and south to Virginia. Winters south to Florida and the Gulf coast. (C. p. platensis breeds from Mexico south to South America).

Habitat Loosely colonial in breeding season. Inhabits moist grass and sedge marshes, bogs and wet fields; does not ordinarily inhabit cattails (Godfrey 1966). Prefers upright grasses or sedges in which to attach and hide the nest. Several dummy nests may be constructed.

Vulnerability Vulnerable to habitat disturbance or alteration, especially on account of its restricted distribution and very low numbers. The population at Kingston Lake appears to have disappeared after a small dam was removed from the area and the damp sedge habitat dried out (J.G. Wilson, pers. comm.).

Sialia sialis (Linnaeus) Eastern Bluebird

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 301.

Distribution (see Map 40). A rare summer resident. Has nested at scattered localities in the settled parts of the province, especially in the south. Breeds from southern Saskatchewan to Nova Scotia, south through the eastern United States and Mexico to Central America. Winters from the central States southward. The New Brunswick population may be assigned to S. s. sialis which breeds as far south as the Gulf states.

Habitat Open and sparse woods, wood edges, burnt land with old standing trees, orchards and farmland (Godfrey 1966). In Charlotte Co., the Bluebird has nested mainly in open blueberry barrens (J.G. Wilson, pers. comm.). Nests in tree cavities, old fence posts, old woodpecker holes or in nest boxes.

Vulnerability Vulnerable to disturbance or habitat alteration on account of its very low numbers. Populations have declined in the past, partly as a result of competition for nest sites with the more aggressive Starling. Provision of additional nest boxes will undoubtedly help to maintain or increase Bluebird numbers in the province.

Sturnella magna (Linnaeus) Eastern Meadowlark

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 352.

Distribution (see Map 41). A rare summer resident, casual in winter. Has been observed in all but Restigouche and Madawaska Co.'s, but all breeding records are for the south of the province (with the exception of a record of presumed breeding in Kouchibouguac National Park). During the 50 years prior to 1939, only 9 sightings of Meadowlarks were recorded in New Brunswick, 5 of them on Grand Manan (Squires 1960). Breeds from southern Ontario to New Brunswick, south through the central and eastern United States to Central and South America. Populations breeding in the northeast are S. m. magna. Other subspecies breed from the southern United States southward.

Habitat Open fields and meadows with scattered trees or posts. Nests on ground.

Vulnerability Vulnerable to habitat disturbance or alteration on account of its low numbers. Included in the annual Blue List of American Birds since 1980 (Tate 1981, Tate and Tate 1982).

Pooecetes gramineus (Gmelin) Vesper Sparrow

Identification Refer to The Birds of Canada by W.E. Godfrey (1966) p. 387.

Distribution (see Map 42). An uncommon summer resident and transient. Sight records are fairly numerous from all counties, but few nests have been found. Singing individuals are common in the New River-Lepreau area of Charlotte Co. in June and July and have also been observed regularly near Springfield, Kings Co. (J.G. Wilson, pers. comm.). Breeds from the British Columbia interior to Nova Scotia, south to California, New Mexico and North Carolina. Winters from the southwestern United States and southern New England south to southern Mexico. The populations breeding in eastern North America are P. g. gramineus.

Habitat Open, usually fairly dry fields, pastures and prairie. Blueberry barrens are the main habitat of this species in Charlotte and Kings Counties in southern New Brunswick (J.G. Wilson, pers. comm.). Nests on the ground.

Vulnerability May be vulnerable to habitat alteration. Included in the annual Blue List of American Birds from 1978 to 1980. Its numbers show continuing declines in the northeastern part of its range (Tate and Tate 1982).

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MAMMALS

In recent times 55 species of land mammals have been recorded in New Brunswick. The Caribou (Rangifer tarandus), Wolverne (Gulo luscus), and Timber Wolf (Canis lupus), have all been extirpated in the province and the Sea Mink (Mustela vison macrodon) is now extinct. The House Rat (Rattus norvegicus), and the House Mouse, (Mus musculus) have been introduced from Europe. Although once common, the Timber Wolf was systematically exterminated in the late nineteenth century as it was considered to be inimical to man's interests. Since the publication of The Mammals of New Brunswick (Squires 1968), two more native species, the Eastern Pipistrelle (Pipistrellus subflavus) and Long-tailed Shrew (Sorex dispar) have been discovered in the province (McAlpine 1976; Kirkland et al. 1979). The Least Bat (Myotis subulatus) has been deleted from the provincial list as the only record has been shown to be based on a misidentification (Gorham 1970).

The small mammals, especially the shrews, mice, voles and bog lemmings, are the least well known mammal group in New Brunswick. Apart from scattered collecting in the Saint John River valley, systematic surveys have been carried out only in Fundy National Park (Prescott and Bateman 1978), Kouchibouguac National Park (Nordstrom and Dilworth 1972) and Mount Carleton Provincial Park (Dalton et al. 1980). The Canadian Wildlife Service is conducting studies at present in the area between Big Salmon River and Upper Salmon River in Saint John and Albert Counties, and in Kouchibouguac National Park in Kent County. Although large areas of New Brunswick remain unstudied, it is evident that certain species have very restricted ranges in the province. On these grounds, the Long-tailed and Gaspe Shrews (Sorex dispar, S. gaspensis) and the Yellow-nosed Vole (Microtus chrotorrhinus) are considered to be potentially vulnerable to habitat destruction. The Arctic Shrew (Sorex arcticus) has not been included

in this report, although a distinct, geographically isolated subspecies occurs in southern New Brunswick and Nova Scotia. At this time, S. a. maritimensis does not appear rare or vulnerable in its preferred habitat of grassy marshlands and open areas about treed swamps and marshes. It should also be noted that distinct subspecies of the Deer-Mouse (Peromycus maniculatus argentatus) and Meadow Vole, (Microtus pennsylvanicus copelandi), are confined to the island of Grand Manan. The study of insular races such as these can provide insights into the nature and rates of speciation in natural populations.

The generally accepted presence of the Hairy-tailed Mole (Parascalops breweri) in New Brunswick is based on a single early literature record (Chamberlain 1884). At that time, Chamberlain stated the species was rare in the province. No specimens have been collected, however, and there have been no adequately documented sight records in the last 100 years. We consider the current status of this mole in New Brunswick to be hypothetical.

Of the seven species of bats in New Brunswick, at least a portion of the populations of three species are known to hibernate in abandoned mine shafts and in the few caves known in the province (McAlpine 1983). Hibernating bats are highly vulnerable to disturbance and this has been a contributing factor to the drastic declines in the populations of many species of bats worldwide (Mohr 1972; Fenton and Barclay 1980). There are indications of a decline in numbers of bats at some New Brunswick hibernacula (McAlpine 1979) and for this reason all four of the cave-dwelling species have been included in this report, even though the Little Brown Bat (Myotis lucifugus) and Long-eared Bat (Myotis septentrionalis) are quite common and widespread in the province during the summer. McAlpine (1983) has reviewed the status of bat caves in New Brunswick and recommended protection for some caves under the New Brunswick Ecological Reserves

Act as well as the posting of educational signs at the entrances of frequently visited caves. On the distribution maps in this report we have indicated bat hibernacula by open circles, as distinct from other records.

The distribution and abundance of large mammal populations in New Brunswick are fairly well known. The Lynx and Cougar are two notable exceptions to this generalization and further information is required on their status and biology in the province. The Marten and Fisher have not been included in this report although they were at one time rare in the province and were protected by a closed season on trapping from 1945-1962. Both species are now common in northern New Brunswick and appear to be expanding their ranges into the southern counties (Dilworth 1974; D. Cartwright, pers. comm.).

Although the marine mammals of New Brunswick coastal waters have not been considered in this report, the status of at least one species is of special concern and should not go unmentioned. In the past several years an important summering population of Right Whales (Eubalaena glacialis) has been discovered at the mouth of the Bay of Fundy. The North Atlantic population of this species has been thought for many decades to be on the verge of extinction, and a recent estimate placed its numbers in the high tens to low hundreds (Mitchell 1974, cited in Gaskin 1982). By international agreement, it has been protected from hunting since 1937 (Katona et al. 1975). A census undertaken in the summer of 1982 showed that at least 69 different Right Whales, including 6 cow-calf pairs, were present in the Bay of Fundy (Kraus and Prescott 1983).

As far as is known at present, breeding and calving of the western North Atlantic population of the Right Whale takes place during the winter months in shallow, relatively warm coastal waters between South Carolina and Florida (Reeves et al. 1978). The whales

migrate northward as far as the Gulf of St. Lawrence in spring and summer in search of productive feeding areas. Two concentrations of Right Whales have been observed in the Bay of Fundy, one in the area between Campobello Island and The Wolves, the other along the northern and eastern margins of the Grand Manan Basin, a large 100 fathom deep trench lying midway between Grand Manan and Digby Neck, Nova Scotia (Reeves et al. 1983). Owing to a combination of oceanographic features, these areas support extremely high concentrations of planktonic invertebrates (especially euphausiids and copepods) during the summer months and constitute important feeding grounds not only for whales, but also for fish, seabirds and other marine mammals (see Gaskin and Smith 1979; Gaskin 1982; also the section on birds in this report).

The Right Whale may be vulnerable in the Bay of Fundy to harassment by high-speed power boats or to unintentional disturbance by overly zealous whale-watching parties. Construction of an oil refinery at Eastport, Maine, proposed for more than a decade by the Pittston Oil Company, would constitute a serious threat to the Right Whale and to all forms of marine life in the area of Passamaquoddy Bay and the Grand Manan archipelago. Transport of oil to the refinery would require regular passage of large tanker ships around Campobello Island, most notably through Head Harbour Passage which presents numerous difficulties to navigation even under the best of conditions.

In the species accounts that follow, information on extra New Brunswick distribution and habitat has been taken from Banfield (1974) and Peterson (1966), unless indicated otherwise.

SPECIES ACCOUNTS

Sorex gaspensis Anthony and Goodwin Gaspe Shrew

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 40.

Distribution (see Map 43). First recorded in New Brunswick in 1961 (Peterson and Symansky 1963). The range of S. gaspensis as now known consists of three sub-ranges: the Gaspe Peninsula of Quebec, northern New Brunswick, and Cape Breton, Nova Scotia (Kirkland 1981). In New Brunswick the Gaspe Shrew has been collected 5.6 km southwest of Mount Carleton near the headwaters of the South Mamozekel River, Northumberland Co., (Peterson and Symansky 1963), on Mount Sagamook in Mount Carleton Provincial Park, Restigouche Co., and on Moose Mountain near Bath, Carleton Co. (Dalton et al. 1980).

Habitat Most often collected on steep, moss-covered talus slopes or along rocky streams. It has also been taken in low elevation deciduous forests with considerable deadfall.

Vulnerability Vulnerable to habitat destruction and possibly to overtrapping by mammologists. Known habitats should be protected from disturbance, logging and construction projects.

Sorex dispar Batchelder Rock or Long-Tailed Shrew

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 41.

Distribution (see Map 44). Occurs in a narrow belt extending from Maine to North Carolina. A disjunct population was recently discovered near Riverside-Albert, Albert Co., in southeastern New Brunswick (Kirkland et al. 1979).

Habitat Inhabits two main types of sites: under and among cool, moist, moss-covered rocks, particularly in talus slopes; and adjacent to cool mountain streams in wooded areas.

Vulnerability Same as for S. gaspensis.

Myotis lucifugus (LeConte) Little Brown Bat

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 63.

Distribution (see Map 45). Common throughout the province. Has been collected during the summer months from Kings, Saint John, York, Madawaska, Charlotte, Gloucester and Westmorland Counties. Taken during the winter from Howes Cave and Harbells Cave in Saint John Co., as well as from caves in Albert and Kings Counties (McAlpine 1983). Occurs throughout most of North America from Georgia to Labrador in the east and from California to southern Alaska in the west.

Habitat From May to late September, roosts during daylight hours in caves, hollow trees or buildings. Females establish nursery colonies in attics or church steeples. At dusk may be seen foraging for insects around street lamps in both rural and urban areas. In late fall, chooses a hibernating site, usually a cave or mine shaft with a stable temperature (2-8^{o}C) and humidity (80-100%) regime.

Vulnerability In New Brunswick, hibernates in abandoned mine shafts and the small number of available caves and therefore is highly vulnerable to disturbance or habitat destruction. Only certain caves (mine shafts) or portions of caves provide suitable habitat for hibernating bats, owing to their relatively narrow temperature and humidity requirements. The microclimate of a cave is the product of its architecture and of the patterns of air and water circulation. Alteration of entrances or ground water flow (e.g. by mining or forestry operations) may thus cause subtle but intolerable changes. Threats to cave habitats and their bat populations are generally more overt: entrances may be sealed for safety reasons, and collapse or excavation may occur as a result of road-building, mining or quarrying. The most significant threat to hibernating bats in New Brunswick at present, however, is human disturbance (McAlpine 1983). Apart from littering and acts of vandalism, any visit during the hibernation period to a cave harbouring bats is likely to cause some disturbance, accompanied potentially by bat mortality.

Myotis septentrionalis (Merriam) Eastern Long-Eared Bat

Identification Refer to Distribution and systematic relationships of long-eared Myotis in Western Canada by C.G. Van Zyll de Jong (1979) Canadian Journal Zoology 57:987-994.

Distribution (see Map 46). Occurs throughout the province. Has been found during the summer months in Queens, Kings, Saint John, Victoria and Gloucester Counties. Collected from caves in Saint John, Albert, and Kings Counties (McAlpine 1983). In North America it ranges along the southern portion of central Canada from Newfoundland to Saskatchewan and south to Florida.

Habitat Similar to that of M. lucifugus. Prefers heavily forested areas, abandoned mines and small caves where it usually clings to moist walls away from draughts. During the daylight hours of summer (May to October), it may be found under loose bark of trees or in rock crannies. In late fall chooses a cool hibernaculum with temperatures of 4-5°C and relative humidity of 90%.

Vulnerability Same as for M. lucifugus.

Eptesicus fuscus (Beauvois) Big Brown Bat

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 74.

Distribution (see Map 47). This bat is not common in New Brunswick. Only three specimens have been recorded: one at St. Andrews, Charlotte Co. (Gorham and Johnston 1962), a second near the Reversing Falls in Saint John, and a third at Mactaquac, York Co. (New Brunswick Museum Collections). The Big Brown Bat occurs throughout most of southern Canada from New Brunswick to British Columbia and southward to Central America and the West Indies.

Habitat Little is known of the habitat in New Brunswick; however, it may be similar to that of M. lucifugus. Elsewhere, will utilize available caves, mine shafts or buildings for hibernacula and can withstand a wide variety of hibernation conditions other than the ideal temperature of 5-6°C and relative humidity of approximately 80%.

Vulnerability Same as for M. lucifugus.

Pipistrellus subflavus (Cuvier) Eastern Pipistrelle

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 72.

Distribution (see Map 48). Uncommon in New Brunswick. Has been recorded during the hibernation period from caves and mines in Saint John, Kings and Albert Counties (McAlpine 1983). This species may prove to be more widely distributed in New Brunswick than present records indicate. Occurs in eastern North America from the Yucatan Peninsula and Florida northward to the Great Lakes.

Habitat Nothing is known of the summer habitat in New Brunswick. A specimen taken February 26, 1976, from Kitts Cave, Kings Co., was found approximately 38 metres from the cave entrance (McAlpine 1976). The temperature at the cave ceiling where the bat was hibernating was found to be 3°C. The Eastern Pipistrelle is usually found in small numbers in hibernacula and does not cluster but roosts singly or in small groups, sometimes among large congregations of Myotis species.

Vulnerability Essentially the same as for M. lucifugus.

Microtus chrotorrhinus (Miller) Yellow-Nosed or Rock Vole

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 164.

Distribution (see Map 49). Apparently confined to the northern portion of the province. In New Brunswick, specimens have been taken in the Tobique Valley, Victoria Co. (New Brunswick Museum collections), the upper Saint John River valley, Madawaska Co. (Peterson 1966), and in the Mount Carleton region of Northumberland Co. (Peterson and Symansky 1963; Dalton et al. 1980).

Habitat Transition zone between forests and boulder beds in steep mountainous areas. Lives in shallow burrows in mossy talus slopes or among rock outcrops.

Vulnerability Possibly vulnerable to habitat destruction. Known habitats should be protected from disturbance, logging and construction projects.

Lynx lynx (Linnaeus) Lynx

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 280.

Distribution (not mapped). Formerly common in New Brunswick (Chamberlain 1884), the Lynx is now rare in the province (Squires 1946), but has not been exterminated as stated by Banfield (1974). The species seems to avoid the more settled areas of southern New Brunswick. Fewer than ten Lynx are normally trapped each year in the province (D. Cartwright, pers. comm.). The Lynx inhabits the broad boreal forest belt in Canada from Newfoundland to the Yukon. It also occurs in the northern United States and Eurasia.

Habitat Extensive tracts of boreal forest. Lynx populations fluctuate in response to the abundance of the snowshoe hare (Lepus americanus), the principal food source.

Vulnerability Vulnerable to increased human activity in wilderness areas, especially to illegal shooting or trapping. The Lynx is a rare species in New Brunswick and since 1976 has been protected under the provincial Endangered Species Act. Forest clearcutting, when carried out in moderation, appears to affect Lynx habitat only temporarily. As soon as cut-over sites are suitable for snowshoe hares, they may be re-occupied by Lynx (W.H. Prescott, pers. comm.). Potential habitat in some areas of the southern part of the province is apparently too fragmented to be suitable. There is also evidence of a general decline in Lynx populations along the southern margin of their range. This is due at least in part to increased competition with the ecologically more versatile Bobcat (Lynx rufus) which has expanded its range northward in recent years (Peterson 1966), and possibly to the increased numbers of the Coyote (Canis latrans) in New Brunswick (D. Cartwright, pers. comm.).

Felis concolor Linnaeus Cougar or Eastern Panther

Identification Refer to The Mammals of Eastern Canada by R.L. Peterson (1966) p. 276. There is some question as to the distinctness of the eastern subspecies of the Cougar, Felis concolor couguar Kerr (van Zyll de Jong and van Ingen 1978). The Eastern Panther is thought to be characterized by its smaller overall size, more reddish coloration and dark dorsal stripe (Banfield 1974). Subspecies are normally distinguished by comparison of series of specimens, including animals from transition zones between presumably discrete races. Because of the small number of extant specimens (van Zyll de Jong and van

Ingen 1978), a rigorous analysis of this sort has not been possible in the case of the Eastern Panther. No eastern Canadian Cougar specimen has reached a museum in over 100 years (Peterson 1966).

Distribution (not mapped; see van Zyll de Jong and van Ingen 1978, Figs. 1-8). The Cougar formerly ranged widely over south-central and eastern Canada and until recently was thought to have been extirpated. An abundance of circumstantial evidence has accumulated, however, including track casts and numerous sightings which suggest the presence of several families in New Brunswick (see Wright 1972). Sightings of Cougar have been reported throughout the province with a concentration of sightings in the south (Parker 1983). Cougar have also been reported from Nova Scotia, Quebec, Ontario (van Zyll de Jong and van Ingen 1978) and even Newfoundland although these animals may have been introduced (Parker 1983, G. Parker, pers. comm.). Prior to European settlement, the Cougar ranged widely in North and South America. At present, it is common in North America only in the more remote mountain wildernesses of the west.

Habitat Little is known of the habitat of the Cougar in New Brunswick. Although largely restricted at present to remote western North American mountain regions, it has been found elsewhere in Canada in a wide variety of habitats ranging from large swampy areas to dense coniferous forests.

Vulnerability The Cougar is considered to be an endangered species in Canada (van Zyll de Jong and van Ingen 1978). In New Brunswick, it has been protected since 1976 under the Endangered Species Act. The Cougar has probably never been common in New Brunswick. Fragmentation of the pre-settlement forest cover and increased human activity are the presumed reasons for its decline. According to known predator-prey ratios in other areas, the current numbers of White-tailed Deer in New Brunswick could theoretically support a population of up to 250 Cougars (van Zyll de Jong and van Ingen 1978). That the actual numbers are obviously much lower than this is perhaps a reflection of the animal's extreme wariness of humans in both inhabited and regularly travelled woodland areas. Wright (1972) suggests that the construction of a highway from St. Martins to Fundy National Park would result in the elimination of the Cougar from one of its important ranges in New Brunswick. Since 1977 the Canadian Wildlife Service has co-ordinated the collection of Cougar sightings in the Maritimes. Cougar report forms may be obtained by writing the Sackville office of the Canadian Wildlife Service (P.O. Box 1590, Sackville, N.B. E0A 3C0).

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DISTRIBUTION MAPS

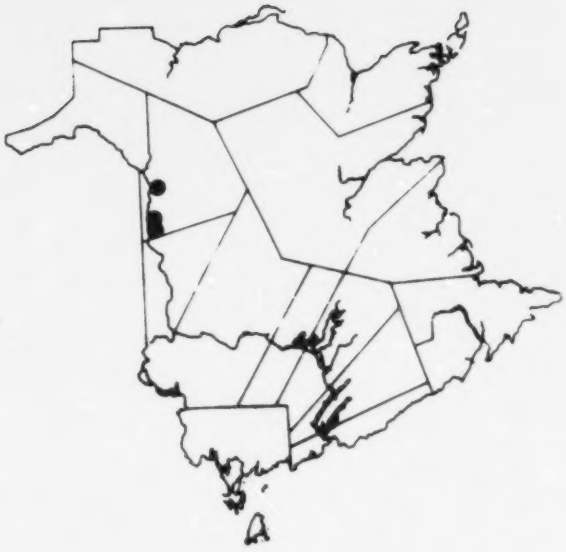
Explanation of Symbols

● Occurrence based on literature reports or material in a museum collection.

○ Birds - occurrence based on New Brunswick Breeding Bird Surveys.

○ Mammals - identifies a bat hibernaculum for designated species.

1. New Brunswick and Counties



2. Pedicularis furbishiae

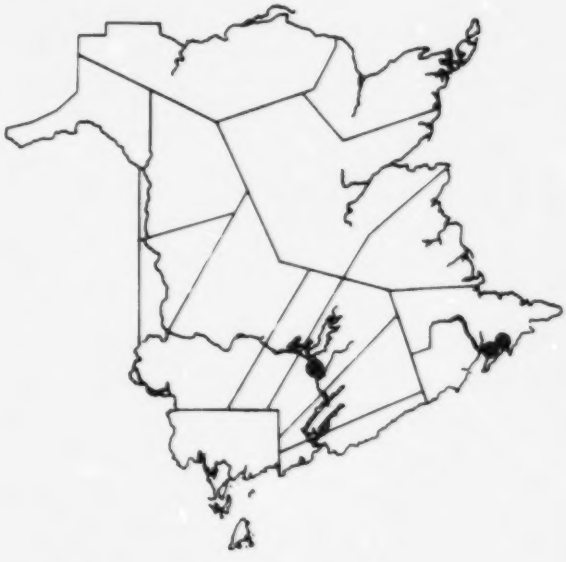
3. Lyogyrus granum

4. Ferrissia rivularis

5. Alasmidonta heterodon

6. Alasmidonta varicosa

7. Lampsilis cariosa



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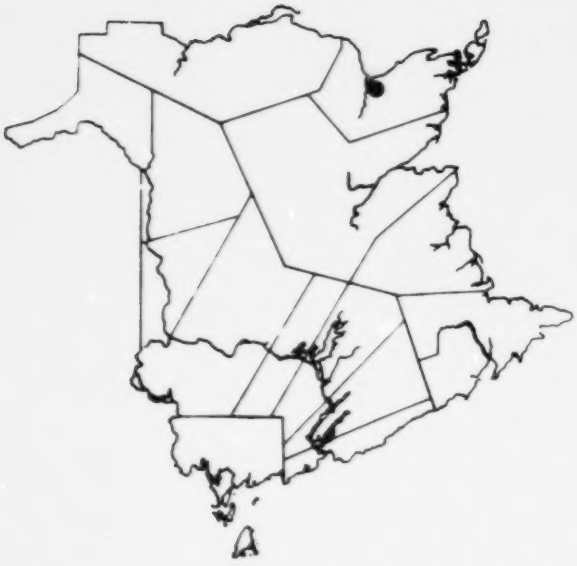

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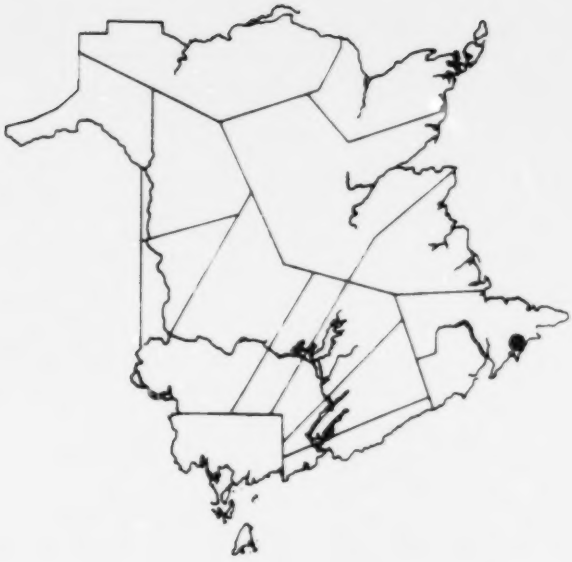

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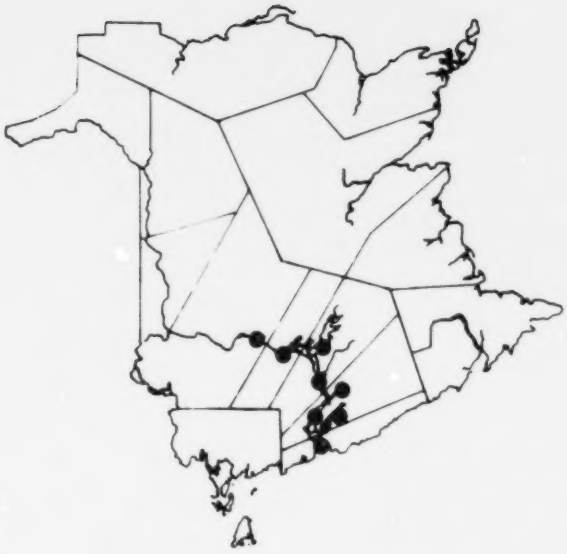
11. Epidemia dorcas dospassosi

12. Papilio brevicauda bretonensis



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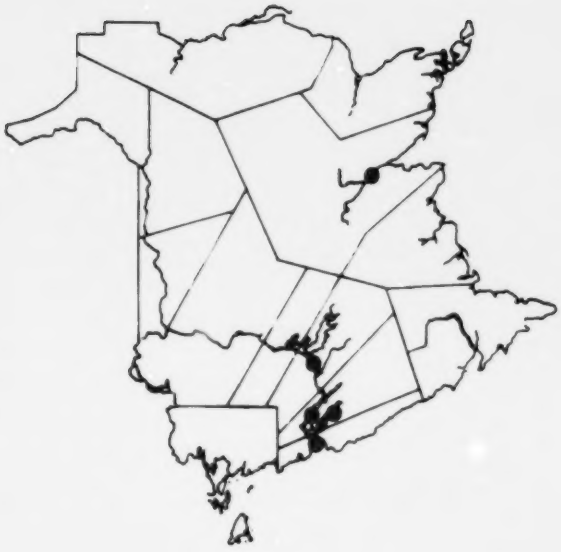
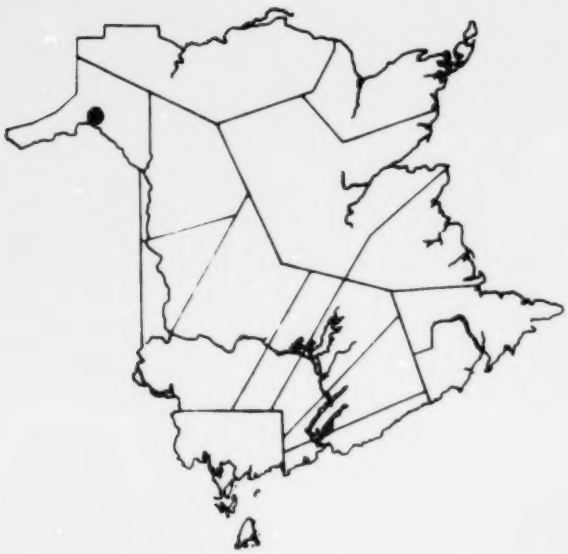


14. Alosa aestivalis

15. Salvelinus alpinus

16. Osmerus spectrum



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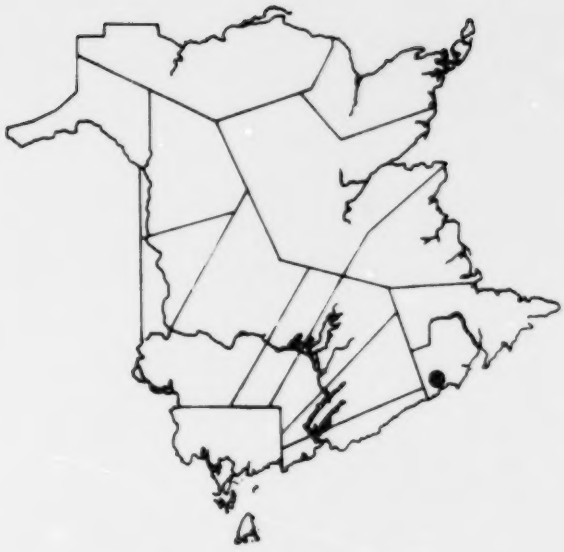

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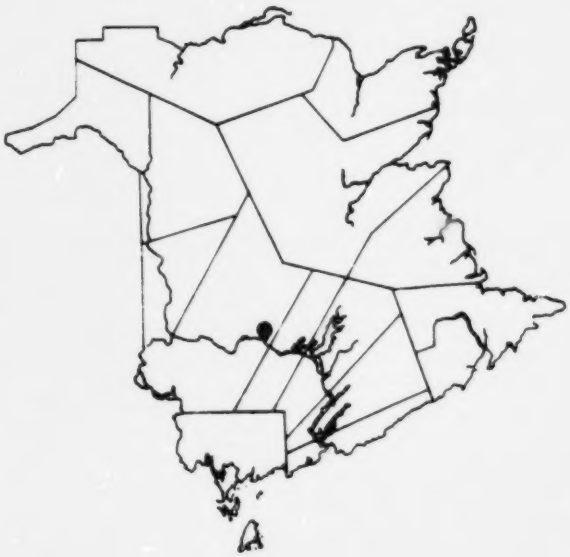

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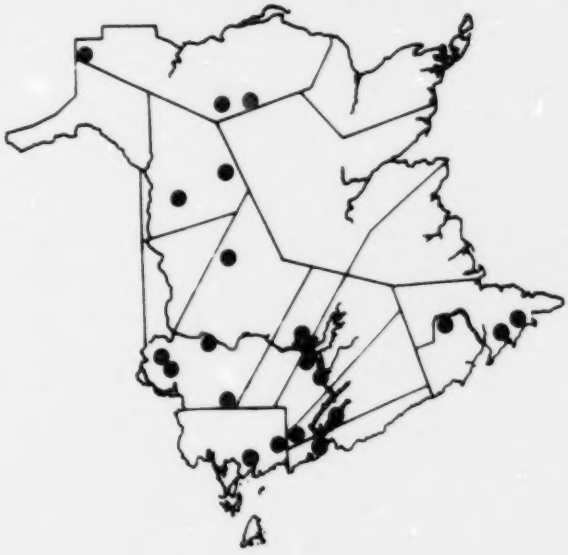

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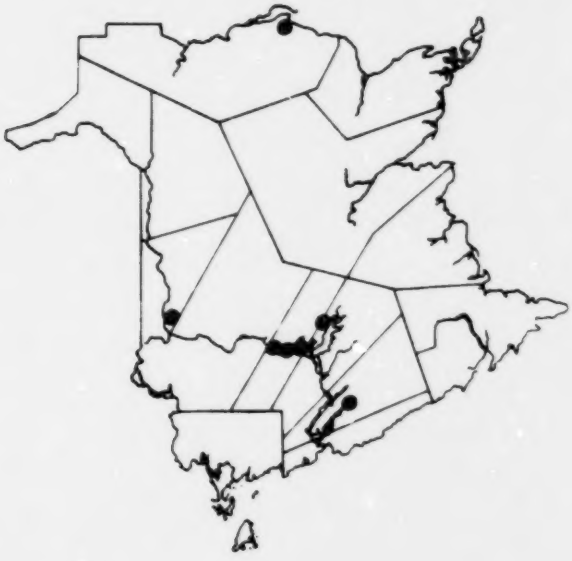
21. Oceanodroma leucorhoa

22. Nycticorax nycticorax



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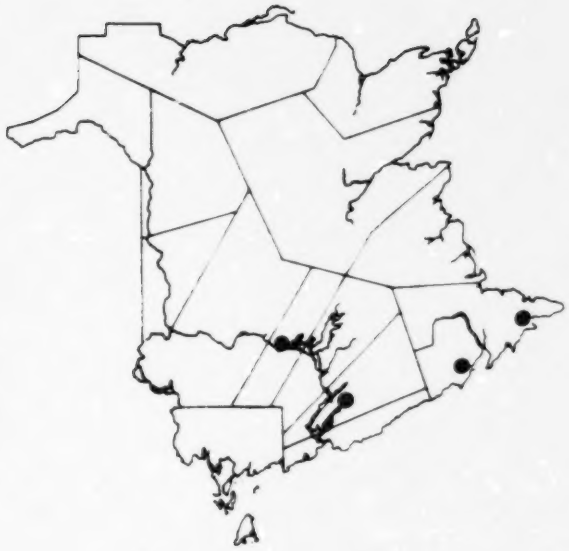
24. Haliaeetus leucocephalus

25. Falco peregrinus



26. Rallus limicola

27. Coturnicops noveboracensis

28. Charadrius semipalmatus

29. Charadrius melodus

30. Bartramia longicauda

31. Catoptrophorus semipalmatus

32. Larus delawarensis

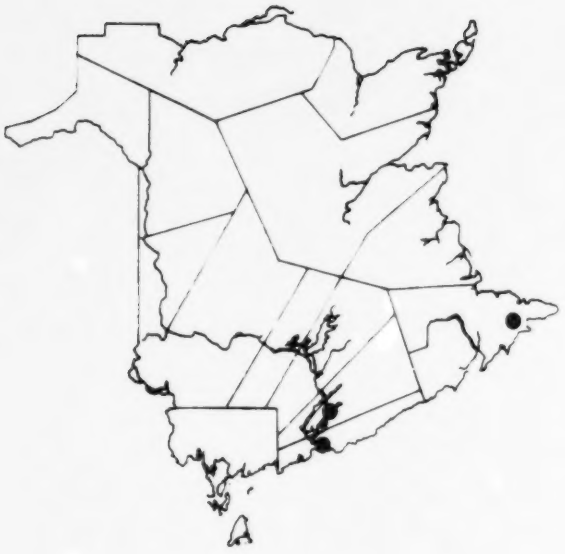
33. Chlidonias niger

34. Alca torda

35. Uria aalge

36. Fratercula arctica

37. Dryocopus pileatus

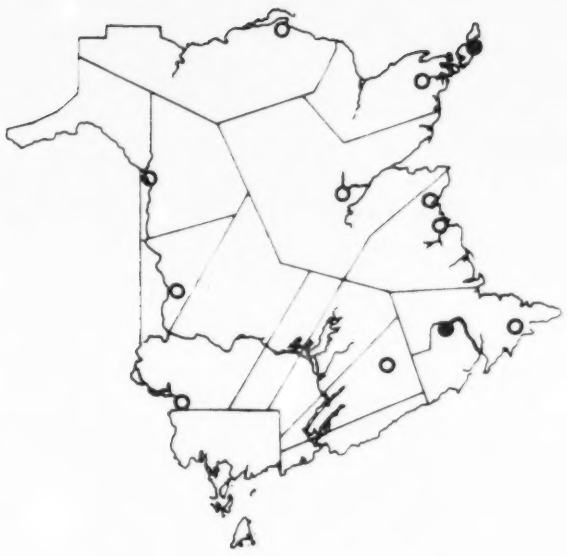


38. Cistothorus palustris

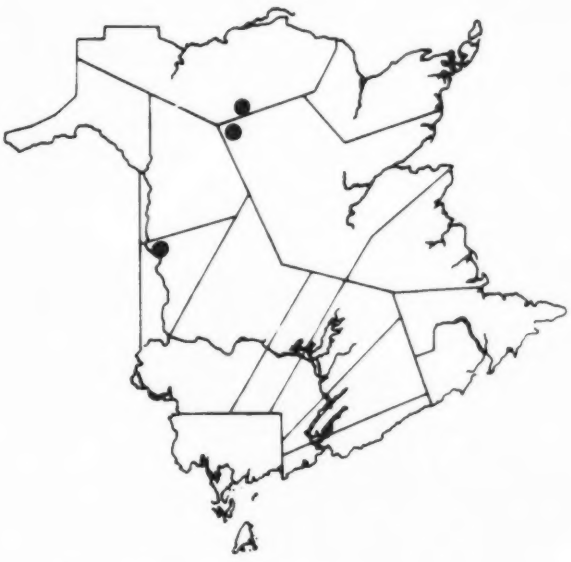
39. Cistothorus platensis

40. Sialia sialis

41. Sturnella magna



42. Pooecetes gramineus



43. Sorex gaspensis

44. Sorex dispar

45. Myotis lucifugus

46. Myotis septentrionalis

47. Eptesicus fuscus

48. Pipistrellus subflavus

49. Microtus chrotorrhinus

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